JOURNAL *of* FORESTRY

June

1935

Vol. XXXIII Number 6

SOCIETY OF AMERICAN FORESTERS 1900

Published by the

SOCIETY of AMERICAN FORESTERS

Single Copy Sixty Five Cents Four Dollars per Year

JOURNAL of FORESTRY

OFFICIAL ORGAN OF THE SOCIETY OF AMERICAN FORESTERS
A professional journal devoted to all branches of forestry

Entered as second-class matter at the post-office at Washington, D. C.

Acceptance for mailing at special rate of postage provided for in the Act of February 28, 1925, embodied in paragraph 4, Section 412, P. L. and R. authorized November 10, 1927.

Office of Publication, Room 810, Hill Bldg., 839 17th St., N. W., Washington, D. C.

Editorial Office, Room 810, Hill Bldg., 839 17th St., N. W., Washington, D. C.—Manuscripts intended for publication should be sent to Society's headquarters, at this address, or to any member of the Editorial Staff. Closing date for copy, fifth of month preceding date of issue.

The pages of the JOURNAL are open to members and non-members of the Society.

Missing numbers will be replaced without charge, provided claim is made within thirty days after date of the following issue.

Subscriptions, advertising, and other business matters should be sent to the JOURNAL OF FORESTRY, Room 810, Hill Bldg., 839 17th St., N. W., Washington, D. C.

CONTENTS

JOURNAL OF FORESTRY

VOL. XXXIII JUNE, 1935 No. 6

The Society is not responsible, as a body, for the facts and opinions advanced in the papers published by it. Editorials are by the Editor-in-Chief unless otherwise indicated and do not necessarily represent the opinion of the Society as a whole.

EDITORIAL

OBSOLESCENCE AND FORESTRY

THE accelerated tempo of modern life has become a commonplace. Never before has man been called upon to readjust his inherited ways of thinking and behaving so suddenly, or at so many points. Unexampled shocks and stresses result. It is a question for the future to answer whether not merely individuals but the general economic and social structure can become adjusted to new conditions fast enough not to crack.

Before all civilized regions of the earth were drawn so close together through intercommunications, cheap transportation, and the spread of ideas, changes took place gradually, and a much simpler economic organization permitted readjustments to be made without profound disturbances. The villager pursued the way of his ancestors with little knowledge of what was taking place elsewhere, and advances were measured in terms of centuries, not decades, years, and even months. Today a fashion-conscious public wants the latest thing; and needs are more and more supplied by great and distant enterprises, employing capital and labor on a large scale and selling upon a national market. Such enterprises cannot readily alter their character to meet new situations. They must keep going at high momentum or go into bankruptcy; and when they fail, the ruin spreads. To prevent capital obsolescence, new inventions are often suppressed, perhaps for years; and the need for assured stability is an important factor in the efforts of giant businesses to obtain some measure of monopoly advantage or restriction of competition in their particular field. Obsolescence due to progress may take place so fast as to be actually wasteful socially, and against the public interest.

For foresters, engaged in growing a very long-time crop and compelled to look far ahead in their plans, the danger of economic changes comes home with peculiar force. How to find a safe middle way between rigid plans based on assumptions of which no one can be sure and, on the other hand, aimless opportunism? How combine flexibility with distant commitments?

A mounting danger is seen that the markets for forest products will be so curtailed by shifts to substitutes as to wreck all the calculations of forest managers and leave investors in timber-growing with their capital sunk in unwanted enterprises. This has inspired advocacy of a greatly enlarged research effort in the field of wood use. But the situation is essentially the same for forestry and the forest industries as for business undertakings in other fields. The risk of capital obsolescence through new inventions, changes in economic demand, or the un-

expected opening of fresh fields of supply may well cause almost any investor to feel insecure.

In the South, hopes are rising that forestry may serve as a new support for an economic structure now gravely weakened by the shifting flow of production and trade into new channels. King Cotton's throne is tottering, in much of his old domain; one question is, will pine succeed him? Another is, why has the old form of land use had to give way?

These southern cotton commitments include extensive manufacturing investments as well as myriads of farms. In 1929 almost two-thirds of the output of the cotton goods industry of the country, in money value, came from the cotton-growing states, to a total of nearly one billion dollars. The history of this industry is itself an illustration of the shifting currents of modern economic life, whereby one region supplants another; the rise in the number of spindles in the South has seriously affected New England. Cheap and docile labor and nearness to the raw material largely explain the change, which may come to be paralleled in the pulp and paper industry if newsprint production in the South fulfills the expectations of those now seeking to promote it.

On the land use side, the invention of the cotton gin, the rise of the textile industry based on power and factory machinery, and the natural advantages of the South as a source of world supply of cotton fiber put King Cotton on his throne. Because of the heavy demand for hand labor in growing this crop, the cotton belt became the most densely populated agricultural region in the United States. This dependent population, as well as the continuance of profitable farming in the older regions of cotton production, is now threatened as new lands to the west, cheaper, richer, and better adapted to the use of farm machinery, raise the production and lower the price; while at the same time foreign markets are being curtailed and foreign production is increasing. A cotton-picking machine that will greatly reduce the labor requirement is said to be at hand; rayon is cutting into the field of cotton use, with consequences both for the growers and for the cotton textile industry; and there is talk of new discoveries and inventions that may lead to the use of other fabrics superior to cotton, and cheaper. Instability and obsolescence threaten from every side.

Somewhat similarly, revolutionary changes may be at hand in wood use for housing construction. What the effect will be upon wood requirements and investments in timber, forest management, and lumber manufacture it would be unsafe to predict. The Forest Products Laboratory is at work in this field. It is seeking to develop new ways of using wood in building, that will make possible lower-cost houses. That the industries engaged in manufacturing other materials are seeking to capture the market is common knowledge. According to press accounts, there was recently on exhibition at the Grand Central Palace in New York a prefabricated house "which can be ordered, erected, and finished in every detail, even to food in the refrigerator, in the space of two weeks." Actual construction of houses of this type in the New York region is reported to be in progress. The material is given as "panels of cement and asbestos, . . . bolted to a steel frame."

It is true that for years we have been hearing, off and on, fairy tales of this or that new adaptation of non-wood material or new technique of construction which would make obsolete the old-time house and greatly reduce the cost of dwellings. While great changes have come in the last three decades, they have come gradually, not cataclysmically. But

however incredulous we may still individually feel concerning the imminence of an Aladdin's lamp prefabricated house that will arrive on the scene within a day or two of its ordering, be put together by two expert assemblers and a half dozen local workers, and be ready for occupancy, with the most ultra-modern conveniences, in a fortnight or so, can we feel confident that a residence worth $10,000 today will bring half that price a few years hence? And what vistas of disturbance in the field of real estate investments, house ownership financing, and labor employment in the building trades, along with wood use, are opened up when the possibilities of wholesale obsolescence in housing and methods of housing construction are pondered?

Technological unemployment is one of the major problems of our day; and it is a problem not merely of the redirecting of labor that has become superfluous in this or that occupation but also of redirecting capital use and land use—all three are tied together. The problem is throughout social as well as economic. Changes much more profound than those within the field of survey of the present discussion may come before a forest crop started now will reach maturity. Whether the risks to which private capital is exposed when long-time commitments are made, anywhere, will tend to check initiative and restrict investment activity the future will show. For foresters, however, whether they are in private or in public employ, the course to pursue seems reasonably plain.

Certainty regarding all that lies in the future is impossible. The best that can be done is to proceed, courageously, on the course which seems wisest in the light of the known facts. Life is always uncertain, but that is no reason for sitting passive, with folded hands. While it is impossible to be sure what the requirements, either in kind or in amount, of distant years will be for commercial products of the forests for which we must make plans now, it is indisputable that a country in which the basic resources have been conserved affords a better prospect for the future than one in which they have been despoiled. Research in every direction is important, to the end that both management practices and utilization methods may make forest use as intelligent as possible; but the question of whether or not public policy should aim at maintaining in useful condition the forest land of the country does not turn on whether or not there exists a known demand for particular products that can be held an assurance of a future market for these same products. To imagine that such an assurance can possibly be secured is to ignore the element of incalculability that the speed of modern progress or change makes so large.

CIVILIZATION AND SOIL EROSION

By W. C. LOWDERMILK

Soil Conservation Service, U. S. Department of Agriculture

CIVILIZATIONS have risen and fallen since the dawn of history. The Chinese alone are unique in that they date their beginnings in legendary antiquity and have continued as a civilization in an unbroken line to the present day. Not until recent years, beginning with George Marsh, has an inquiry been seriously made as to the part that mismanagement of soil has played in the decline or the destruction of a civilization, and the inter-relation between civilization and erosion.

Present day archaeologists, in their post-mortems on excavations of ruins of ancient civilization, have revealed some very illuminating information. They now tell us that some former civilizations, once revelling in a Golden Age of prosperity and surrounded by magnificence and opulence, are crumbled in ruins, half buried in the dust and debris of their own destructive exploitation of the lands they once cultivated. Expeditions of the writer into northwest China revealed that it was the destructive handwork of man more than climatic changes which reduced those once prosperous and rich regions to a land of poverty and decadence.

Aerial photographs of ruins in Asia Minor, Palestine, North Africa, and Peru are strikingly similar. All such ruins are in regions of scarce vegetation, bare hillsides, and rocky lowlands. History tells of vast armies surging back and forth across these regions. They must have been entirely dependent for food upon the surrounding country. Yet, now those barren, dry lands scarcely sustain the scattered native populations.

The great despoiler of civilizations and landscapes is soil erosion, by wind and water. It is a disease which has followed mankind throughout the centuries in his exploitation and destructive treatment of the good earth from which he received his sustenance—a disease, difficult to discern at first and responsive to treatment in the early stages, but absolutely fatal to civilizations in its final stages.

As the civilizations increased in population the crop demands upon the surrounding lands became greater. In the arid regions, enlarged herds overgrazed their hill lands, destroying the vegetative cover and grinding with their hoofs the ground to powder. The exposed soils in dry seasons were swept aloft and blown by the wind and in rainy seasons were washed down the slopes by torrential flows to ruin the fertility of the lowlands. Cooke believes that the Maya civilization had to migrate because it was choked to death by mud washed from its own hillside corn patches. Palestine and north China cut off their forests as the increased demand for food required the cultivation of the slopes. According to the steepness of the slopes, the rich humus soil which had been centuries in the making washed off in from three to twenty years, leaving the land sterile, rocky and bare, unprotected, and each rain dumped debris on the fertile lowlands or choked the irrigation canals and rivers with silt.

This accelerated erosion as an enemy of civilization is not the geologic erosion which slowly cut through rock formations, rounded off the hills and filled in the valleys, and carved, like slow moving glaciers, the grandeur of canyons and gorges. But this geologic erosion does act as a measuring stick to show the

rapidity of accelerated or man-induced erosion.

No nation in the history of the world has gone at the destructive exploitation of its natural resources with the rapidity and thoroughness that we have here in the United States. Coming events cast their shadows before them. Therefore, if we as a civilization are to be saved from the fate of some of these former decadent and fallen civilizations, it is imperative that we launch a coördinated land-planning program for the conservation of our forests, agricultural and range lands, and our water resources.

The Physical Crisis of Land Use

The present physical crisis in land use within the United States is a consequence of the period of exploitation in the rapid occupation of the North American continent by the American people. The time when worn out land can be abandoned for virgin soils lying to the West, with their stored fertility, is gone. Practically all the lands of the country best suited to agriculture have now been occupied. The old agricultural frontier has dissolved into the Pacific; the new frontier has reappeared under foot on the farms now under cultivation. In like manner, the forest frontier is being destroyed. The fundamental problems of land use now reside in the conservation of soil, forest, and water resources and in intelligent soil and forest, range, and farm management.

A brief review of the course of occupation of the American continent aids in clarifying certain problems of present land use and in forecasting some of the exigencies of a future soil-conservation and land-use program so vitally essential to sustained use of our land and forest resources.

Except in an insignificant way, the aborigines of North America had done little to cultivate the soil or to change the virgin character of the land surface and its vegetation. The coverage of vegetation and the soil protected by it were natural responses to long processes of soil and plant development under favorable climates. The streams bore oceanward the residue of precipitation waters that flowed gently from sloping areas and nourished vast unbroken stands of vegetation. Rivers draining the regions covered with dense vegetation generally ran clear except in high flood, when channel erosion furnished the major burden of silt. This channel erosion generated soil creep from vegetated slopes and in addition to the processes of solution, served to sculpture and wear down the land with the leisure of geologic processes. Moreover, where comparatively rapid differential land uplift through deep-seated geological processes had occurred or within climatic zones too rigorous or too arid to support an unbroken cover of vegetation, storm waters carried substantial quantities of silt and erosional debris into drainage streams. Processes affecting the land proceeded in these instances at more rapid rates; streams ran muddy throughout most of the year, as in the instances of the Missouri and Colorado.

In the broad expanses of the country, from semi-tropical to boreal climates, from humid to arid conditions, there spread before the eager colonists an infinite variety of conditions. By far the larger area was completely covered with vegetation, ranging from grasses to dense forests. Such coverage had, in the long period of interdependence of soil formation and vegetative succession, protected the land surface from rainwash and wind blast and favored a ready absorption of rain and melting snow by deep soils, honeycombed by the burrowing of insects and plant roots and otherwise made porous by natural processes of soil development. Little surface washing occurred.

Certainly the processes of erosion, which may be designated under these circumstances as geologic norms of erosion or normal erosion, had not proceeded at rates in excess of soil formation from the materials of the substratum; for beneath the mantle of vegetation lay the nourishing soils of varying depths, the product of intricate process of soil formation over incalculable periods of time. This fact is of highest importance in considering problems affecting long-time planning in land use. Soil erosion had not exceeded soil formation from beneath, under the natural conditions obtaining prior to the "agricultural conquest" of the forested and grass-covered lands of the nation.

Into this pristine continent entered the colonists with a burst of energy that began a transformation of the land at a rate probably never before occurring in the history of any nation, and with it the creation of fabulous wealth. There were reservoirs of populations in Europe which supplied, in a comparatively short time, millions of vigorous people to clear away the forests and to cultivate the soil as the agricultural and forest frontier was rapidly pushed westward. It was no steady infiltration into undeveloped regions, but a rapid advance over a wide front by farmers, lumbermen, and stockmen with their plows, axes, and herds. Frontiers were pushed farther and farther westward at a pace that eliminated planning or even thought of the effect of man's activities upon the abundant natural resources that everywhere swept away to the horizon. Man was busy clearing the land of forests, "subdueing the wilderness," slaughtering the buffalo for their hides, and breaking out first the sod of the prairies and then the short grass of the plains on the west. In his eagerness, the settler lost sight of any need for conservation and failed to sense his stewardship of the new-found continent.

Withal, it is only necessary here to call attention to the significant changes in rate of erosional processes occasioned by the clearing and burning of forests and other vegetation, the breaking of the soil with plows, and the heavy consumption of the forage herbage by rapidly multiplying herds. Soils which had been thoroughly protected through thousands of years of time by unbroken mantles of vegetation, and, for this reason, had weathered to fine textures with high organic contents so favorable to "mellowness" and good fertility, were suddenly exposed to the dash of torrential rains characterizing the climate of extensive regions. There began under these conditions a rate of soil erosion greatly in excess of the rates that hitherto obtained. The significant fact of this period of indifferent land use, still continuing over an expanding area, is that the rates of soil removed by rainwash greatly exceeded, and still do exceed, the rates of soil formation over vast areas—a sure process of land destruction. Topsoils have been literally washed away, leaving raw, comparatively unproductive, unabsorptive, intractible subsoil exposed at the surface, broad instances of which condition are conspicuous throughout the major agricultural soil provinces of the nation—as the Piedmont Plateau, the areas of rolling glacial and loessial soils, much of the Atlantic and Gulf Upper Coastal plains province, the Great Plains region, and the greater part of the crop and grazing areas of the West. Moreover, concentration of runoff has removed the topsoil and cut enormous gullies deep into the underlying subsoil materials, from which true productive topsoil is formed only through ages of natural processing. These gullies are cutting headward and laterally into valuable farms and forests, discharging with maximum speed the concentrated rainfall descending from the upper watersheds

into drainageways and upon valley lands. So malignant and ruthless has been the work of accelerated erosion that the productivity of millions of acres of rich, virgin farm land in densely populated regions of the United States has been destroyed within less than a century.

It is estimated on the basis of erosion and soil surveys, that already the utility of approximately 51,000,000 acres of formerly good farm land has been essentially destroyed, in so far as the production of cultivated crops is concerned, chiefly by gully erosion. This represents an area about the size of Pennsylvania, Massachusetts, and Connecticut combined, or the entire State of Kansas. From about 125,000,000 additional acres—land still largely in cultivation—the topsoil, representing the most productive part of the land, has been washed off or largely washed off by the erosive action of unrestrained runoff. In addition, approximately 100,000,000 acres of cultivated land are heading in the direction of the 125,000,000 acres of impoverished, soil-stripped land. These prodigious losses do not take into account the widespread and increasing erosional wastage over the vast domain of the western grazing areas.

This wastage of the most basic and indispensable resource of the country—the soil—has become one of the most important problems confronting the nation. From a country with the greatest proportional area of rich agricultural land we are plunging, almost heedlessly, in the direction of a nation of predominantly poor agricultural land, as the result of accelerated soil erosion.

The economic and social aspects of this tragic fact have been tremendous. The acceleration of erosion in the East and in the South, in the North and in the West, has reached an annual cost to the nation estimated at $400,000,000 as measured by soil depreciation and reduced yields alone; and has carried with it consequences of first importance to the permanence of investments in the billions of dollars in navigation, water power sites, municipal water supply reservoirs, irrigation developments, agriculture, and grazing. Accelerated erosion has combined with and speeded up runoff of surface water from bared slopes to accentuate flood peaks and to augment the cutting power of stream flow. Equally significant has been the transformation of fertile soils into troublesome sediments. Products of soil wash and gully excavation have been carried by storm flows to be deposited in stream channels and in existing reservoirs. Shoaling of streams and rivers has followed large-scale erosion of upland soils. Particularly significant and important is the rapid rate of silting which is going on in reservoirs located on streams within critically eroding areas of the country, in the East as well as in the West.

The Process of Soil Erosion

When the bared surface of a soil, hitherto protected by a mantle of vegetation, whether forest, brush, or grass, is exposed to the impact of rain and wind, erosional processes of a new order are set in motion. They proceed at a greatly accelerated rate over the slow surface plantation that went on under natural conditions. Quantitative measurements in researches have disclosed the rates of runoff and erosion, as well as some of the fundamental processes involved, under both natural and disturbed ground conditions. Essentially the mechanics of the process are as follows:

The natural covering of vegetal mold and litter prevents the throwing of soil particles in suspension by precipitation waters, and thus the water remains clear. In this way the interstices and hidden channelways of the soil are left open,

favoring maximum percolation of clear or relatively clear precipitation waters. On the other hand, when the surface is stripped of this protective covering, by whatever agent, pelting rain and dashing wash churn the bared soil into muddy suspensions, which, in percolating into the soil, filter out near the surface to choke the pore spaces and natural conduits into the soil with fine soil particles, thus reducing or entirely stopping percolation into the soil. Accordingly, the runoff is increased, and with it goes increased quantities of suspended soil. This surficial runoff accumulates into rills, streamlets, and streams, and the cutting and transporting power is increased many fold, as determined by experimental measurements.

Types of Water Erosion

Accelerated soil erosion may be classified into water and wind erosion. Water erosion may be considered under (a) sheet erosion, (b) rill erosion, and (c) gully erosion.

Sheet erosion.—Sheet erosion is by far more common and more destructive than other types of soil wastage. It is much less conspicuous, because of its general occurrence over large areas and its insidious, less readily observable manner of action. Sheet erosion relates to the slow process of removing a thin sheet of soil more or less evenly from entire sloping lands with every heavy summer rain and even with the melting of snow. It usually proceeds on cultivated fields without being noticed by farmers, at least not until the evidence is called to their attention. Farmers often have noted with surprise that their soils change in color from dark to light, without recognizing the cause—erosion. "Clay galls" usually are evidence of subsoil spottedly exposed by erosion, and where such patches of clay occur the areas between generally have suffered by sheet washing in varying degrees. The presence of gullies usually means also that the inter-gully areas have been stripped of all or part of the more fertile topsoil. Aerial views frequently reveal sheet-eroded land by the lighter colored splotches across the landscape. Many farmers have deplored the progressive reduction in crop yields without recognizing the loss of the topsoil from their fields, and are now farming heavy, intractable clay subsoil instead of the original mellow surface soil. Sheet erosion is a thief that stealthily robs the land of the rich topsoil.

Sheet erosion occurs in a similar manner on forest lands which have been burned clean of the forest litter and protective mantle of forest growth. Grazing of range lands to the ground likewise induces sheet erosion on extensive areas.

Rill erosion.—Rill erosion is characterized by diminutive gullies, often only a few inches deep and quite narrow. These are formed by streamlets of water accumulating over bared soil surfaces. The development of rills is dependent on rainfall in quantity sufficient to result in rapid collection of the surface water into streamlets having strong cutting and transporting power. Thus, heavy rainfall of high intensity falling on land of reduced absorptive capacity stimulates rill erosion. The silty soils are the most susceptible to this type of soil wastage.

On cultivated fields following rains, plowing the soil obliterates the rills and the farmer soon forgets that he has lost a considerable part of his limited capital of humus-charged topsoil. In denuded forest and range lands rills are not thus obliterated, but serve for the concentration of each subsequent heavy rain and therewith the cutting power of runoff waters. Then ensues a most fascinating race between the healing effect of vegetative succession and the cutting power of surficial runoff.

Gully erosion.—Gully erosion is the death stage in the cancerlike eating process of water erosion. Rills, if neglected, develop into gullies, which cut into the soil and the subsoil beneath like rip-saws. They concentrate the flood waters, tear out rich alluvial valleys, and drain off ground water and moisture supplies, so that range lands of the Southwest, especially in Arizona and New Mexico, formerly a paradise for herds, have been reduced to scanty carrying capacity and the water table has been lowered dangerously over extensive areas. In this region, due to the baring of the hillsides by overgrazing, gullies by the million have developed in recent years. The San Simon Wash in the Gila River Valley has gouged out through former alluvial grass meadows a diabolical gash of destruction 60 miles long, 100 to 300 feet wide, and 10 to 110 feet deep. Such gullies have seriously threatened the Navajo Indian lands as well as the grazing industry of other western regions. Most of these gullies are of recent origin, as testified by local cattlemen who remember the region when the vales were once wide expanses of high, waving grasses. Millions of acre-feet of soil are moving down as silt, to be deposited in the reservoirs of the West upon which large areas and prosperous communities are dependent for irrigation and water power.

Wind erosion.—Until recently, destructive movement of soil by wind has largely been associated with areas of deep sands and the western deserts and Bad Lands of the arid regions. Within the past few years the problem of wind erosion has become increasingly grave. In some regions it has become so destructive that the public has demanded that the problem be recognized and control measures undertaken.

Under normal conditions of ground cover and stability, wind erosion, like water erosion, proceeds slowly. Across millenia, wind, supplementing the activities of water and rock weathering, has been a powerful agency in transporting soil material, sculpturing the earth's surface and carving fantastic patterns from rock and unconsolidated geologic strata. This has been especially true within areas of arid and semi-arid climates. Large belts of wind-blown or loessial soil have been formed along the Missouri, the lower Mississippi, the Columbia River, and in other parts of the country.

With the advent of cultivation and grazing the action of wind erosion was accelerated far above the rates which obtained under undisturbed conditions, particularly in treeless regions. At first it was local and infrequent, with dust storms and whirlwinds that were annoying but not generally destructive. As cultivation became more extensive and intensive, the surface soil lost its resistance to the frequent strong winds, and steadily the process was accelerated. Destructive wind erosion, accordingly, became a serious problem in various critical regions.

The major factor favoring accelerated wind erosion is the alteration of the surface soil by cultivation and overgrazing. Wind erosion also occurs to some extent following forest fires. The loose sandy lands in the plains regions generally begin to drift on cultivated lands immediately after plowing. The finer grained soils, however, are more resistant. Nevertheless, these, with continuing cultivation, lose their firmness. Cultivation destroys the mechanical holding effect of native grass roots and favors depreciation of the absorptiveness of the spongy humus contained in the virgin soils. Depletion of the organic supply and constant stirring of the soil develops a highly pulverized, loose condition. Winds sweeping across the bare, dry surface lift the smaller, lighter particles into the high pathways of air currents and carry dust aloft to great distances, as was the case in the

great dust storm of May, 1934, and in the spring of 1935. The coarser, less productive particles left by this process of wind sorting roll or leap along the surface until stopped by some obstacle in the pathway, thus covering fields of good soil and burying fences and other structures.

Principles of Safe Land Use

The national soil erosion reconnaissance, recently completed by the Soil Erosion Service, portrays an enormous wastage of the soil resources of the nation.

Our land areas are enormous in extent, but good lands suitable for crops are estimated at only 461,000,000 acres. Since 51,000,000 are essentially totally destroyed for crop production by soil erosion and 125,000,000 acres more have lost most of their topsoil, the problem for the maintenance of our present standards of civilization must be faced as a national problem of first importance.

Experimental research has defined a few fundamental principles in safe land usage.

(1) A virgin soil profile with its natural mantle of vegetation usually represents conditions of maximum absorption of precipitation waters and maximum erosion control.

(2) Soils cleared of their natural vegetation, whether by burning or cultivation, are subject to greatly accelerated erosion, varying with slope gradients, composition of the soil, and intensity of rainfall.

(3) Soils which have been depleted of their organic content are less absorptive and are easily eroded.

(4) The necessary clearing of land for cultivation of crops, particularly on sloping lands, requires the introduction and use of measures of soil conservation to fit the particular characteristic of regions, and adaptabilities of soils.

The present economic depression has focused attention on the natural resources of the country. Never before has such study been given by the people and its representatives to the conservation of our natural resources. The results of long, patient, but unheralded researches have been given nation-wide publicity and have furnished confidence and assurance in the development of measures of conservation in land and water resources. Only a beginning has been made, however, in the experimental studies of inter-relations of soil, vegetation, and rainfall, and in the social economics of land use to establish the basic information required for the sustenance of the North American civilization within its land area. Soil erosion, with all its concomitant evils of land wastage and flood damage, is a menace which must be faced with an open mind and diligent research and efficient application of tested and proved practices of soil and water conservation. This challenge must be met by the contributions of all serious students of these problems.

INTEGRAL LAND RECONSTRUCTION

By WARD SHEPARD

Office of Indian Affairs, Department of Interior

A NEW and vitally important step in American conservation passed almost unnoticed when on April 27th the President signed the bill creating a permanent Soil Erosion Service, and authorizing the consolidation into one unified agency of all federal soil erosion activities. The speed with which the bill from its first inception last December was enacted into law is symptomatic of the sudden conversion of the American people to a consciousness of the menace of soil erosion to the very existence of this nation. It is significant that at the very moment Dr. Hugh Bennett was testifying before the Senate Committee on behalf of the bill one of those menacing dust storms from the incipient Sahara of the Great Plains blew into Washington, and, darkening the committee room. bore silent witness to the truth of Dr. Bennett's words.

Soil erosion is only the end result of a complex social, economic, and philosophical dislocation; and the cure of soil erosion passes far beyond mere engineering to a radical alteration of our social and economic philosophy. It is because the Soil Erosion Service, under the dynamic leadership of Hugh Bennett, has created a technique for replacing an outworn destructive philosophy of land use with a new, integrated, and humanized philosophy, that its work must rank among the most brilliant conservation achievements in history. And this in spite of the fact that the Service was hastily improvised by the Public Works Administration as an emergency organization primarily for work-relief, and was confronted with the fact that neither the technique of integrated land rehabilitation nor the personnel to carry it out was yet in existence.

In spite of these handicaps, the Soil Erosion Service in two years has launched 40 demonstration areas averaging 150,000 acres each, with the execption of the large western projects, on a considerable number of which the work has advanced so far as to give the most visible, concrete evidence that integral land rehabilitation in this country is no longer a dream, but a startling reality. Under the most diverse conditions, ranging from eroded, gullied hill-farms of the Piedmont to the wind-swept plains of Kansas, and from the vast, high, over-grazed country of the Navajos to the farmed-out, cut-over mountains of West Virginia, this guiding principle of integral land reconstruction has been flexibly and startlingly applied with a variable technique suited to the physical, economic, and human facts of the individual situation.

A concrete example will illustrate this point. In Roane County, West Virginia, the fine hardwood forests were cut out a generation ago, the steep slopes were converted to pastures, and the narrow bottom lands and lower slopes were used for farming. In spite of the fact that the county agent through many years of devoted labor had introduced high-grade Hereford cattle on most of the farms, the soil productivity, and hence the economic base of the region, were steadily declining. Erosion—though not yet having reached the stage of deep gullying—was invading the bottom lands and the worn-out pastures, and the last remnants of forests were disappearing under the ax and the hungry quest of cattle.

The Soil Erosion Service stepped in

and attacked the problem as a whole. "To what end thoroughbred cattle," it asked, "if the very basis of human existence in the region is being destroyed?" In an area of 522 square miles, it classified the land for its best permanent uses, and proceeded to make a large-scale demonstration of land conversion to such used. It selected a large number of farmers who were willing to cooperate by donating time and materials and by entering into a five-year contract to follow the new practices.

In the bottom lands and on the gentle slopes, "strip cropping" was adopted, mainly in order to keep the maximum amount of vegetative cover on plow land the year round, but also to diversify and enrich the cropping system away from the physically and economically destructive one-crop method. The lower and middle slopes are being converted from wornout pasture, infested with weeds and cut by gullies, into permanent pastures by fertilizing with lime and other fertilizers and by sowing good grasses. Gullies and steeper slopes are being reforested with locust, to be supplemented later by other species as planting stock becomes available. The remaining forests are being put in order by "stand improvement" cutting with the help of the C.C.C. Fence lines are relocated to fit the new map of land use.

In Roane County the erosion conditions are as yet relatively simple. Yet if the reconstruction program now started is carried through a period of twenty years it will profoundly alter the physical condition, the economic structure, and the social life of the region. It is probable that in this area forest destruction, over-pasturing, and one-crop farming have destroyed two-thirds of the potential soil production, and have thereby created a rural population precariously subsisting on a fruitless soil, made sterile through human ignorance and the false economic ideals implanted in us all by nineteenth century utilitarian "philosophy."

I might, if space permitted, cite other more striking examples, such as the Navajo project, where simple but beautiful methods of engineering are recapturing the floodwaters that now rush headlong down the steep gullies created in recent years, and spreading them over the floodplains to grow grama grass and Indian maize for an Indian race brought to the verge of starvation through adopting the white man's land-gutting philosophy.

The Soil Erosion Service is creating not merely a new technique of land and economic reconstruction, but a new kind of technician to carry it out. Each erosion control demonstration area has a staff of engineers, agronomists, foresters, extension workers, and other experts. I noticed a striking thing about these men on every demonstration area I visited: namely, that each of them was not only a specialist in his own field but had become—or was becoming—something new in the world: an expert in integrated land reconstruction. These men have achieved a new technique of dealing both with the land aspect and the human aspect of rural life, and this technique has given them a new philosophy of human behavior and human action. The soil erosion demonstrations in this respect are like the famous bronze doors of Ghiberti on the baptistery at Florence, which in the twenty years of arduous labor—artistic and technical—required for their perfection created a new art and a new race of brillian artists.

The lesson of this new philosophy of human action—call it "extension" work or what you will—must not be lost. To keen observers it has long been apparent that there is some fundamental, latent weakness in agricultural and forest extension in this country, in spite of the fact that extension workers as a group are loyal, devoted, and able workers.

How otherwise account for the radical and complete breakdown of our agricultural economy and for such facts as continued soil and forest destruction throughout the farming areas of the country? I will venture my own diagnosis of the fundamental cause: it arises from a philosophical defect, namely, the preoccupation of extension workers with the "project" method, which focuses attention on increasing or improving the production of one thing at a time—Hereford cattle, for example. This over-specialization on single-tracked ideas accounts largely for our failure to achieve anything approaching a living philosophy of rural life. I suggest that the "project" method should be displaced by the 'integral" method of extension. That principle dictates the focusing of extension work on *regions* instead of on *subjects*, on the objectives of rural life as a problem in living instead of on bees, poultry, or white-faced cattle.

The Soil Erosion Service has made a very large start in this direction. For that reason the importance of its work goes far beyond the control of soil movement. It is laying the firm foundation for a new philosophy of living on the earth and with the earth. Its demonstration areas should become training centers for all workers engaged in checking the downward trend of our national life that originated and grew to disastrous proportions during the great era of exploitative individualism.

THE broad objective of land planning should be the greatest good to the largest number in the long run, as distinguished from merely exclusive individual profit or advantage. In the past the application of this principle has been made to a few specific resources, such as minerals, timber, etc., in limited areas. The new objective requires its application to areas and regions in terms of all forms of land use and the adequate integration of the various uses in an area. . . .

The ideal is to be approached through focusing planning activity on areas of obvious maladjustments in land use and resulting economic and social distress. Through experimental handling of such areas, practicable methods and means may be worked out for the solution of land problems, broadening gradually into general planning policy and procedure. Thus the long-time policy and planning organization and objectives will develop naturally out of the current experiences.

At present a large number of federal agencies are engaged in land acquisition in accordance with their various specialized objectives. There is serious need for integrating these various undertakings, not only among themselves but also with the land acquisition programs of the states, in order that the pattern of public ownership may be symmetrical and the specific areas of land be put to the form of use and the type of ownership most consistent with the general welfare. . . .

Initial attention should be given to areas where there are serious problems of economic dislocation, such as tax delinquency, extensive areas of "idle" land for which no constructive policy of use exists, submarginal farm lands, and special areas proposed for acquisition by federal or state agencies.—*Report of the Land Planning Committee, National Resources Board.*

THE ACCUMULATION AND RATE OF MELTING OF SNOW AS INFLUENCED BY VEGETATION

By C. A. CONNAUGHTON

Intermountain Forest and Range Experiment Station, U. S. Forest Service

On many watersheds of the West, the climatic and physiographic factors are such that fully 75 per cent of the usable streamflow originates from winter precipitation. Since such a large portion of the usable water is a product of precipitation during this season, it is evident that one of the major influences of the vegetative cover on many watersheds is its effect on the accumulation and melting of snow. The importance of vegetation is emphasized further by the fact that it is subject to modification, and the value of a watershed can be either enhanced or impaired through management of its plant resources. The part that plant cover plays in regulating streamflow has been recognized in numerous instances, and oftentimes rather drastic methods of management of timber and grazing lands are recommended to facilitate watershed protection.

The study upon which this report is based was an outgrowth of a recommendation regarding timber cutting on the Boise River watershed, in central Idaho. Much of this watershed supports a stand of virgin ponderosa pine timber, and in an effort to improve streamflow for irrigation it was suggested that no future cutting of timber be permitted thereon. Little well-founded quantitative data were available either to refute or to substantiate the validity of this suggestion under the conditions represented on the watershed, and as a consequence this study was undertaken.

The accumulation and rate of melting of snow were investigated for a denuded area and four types of plant cover during the winters of 1931-1933. The denuded area was selected beyond the zone of influence of any vegetation, and it was used as a base with which to compare conditions of plant cover representing sagebrush, reproduction 20 to 25 feet in height on a cut-over area, virgin timber having no advance reproduction, and virgin timber having a dense stand of advance reproduction.

Methods of Investigation

Five plots located within a radius of ½ mile were selected for this study. All were situated on level ground and each represented a distinctive type of vegetative cover. The denuded plot which was entirely free of any vegetation and the plot supporting a dense stand of sagebrush were outside the zone of influence of the forest. Snow measurement points were established at random on each plot, the number varying slightly with the complexity of conditions represented. Fifteen points were established on the denuded plot, 25 each on the plots representing sagebrush, reproduction, and virgin timber having no advance reproduction, and 35 on the plot having virgin timber with advance reproduction. The general aspect of the plots in the timber is similar to that in many stands of virgin ponderosa pine, although the volume per acre and site are considerably better than the average found in the Intermountain Region. The stand of almost pure ponderosa pine on the two plots in virgin timber averages approximately 60 M board feet per acre, and the larger trees reach a height of 160 feet. The advance reproduction found on one virgin plot and on the reproduction plot occurs in more or less small, densely stocked groups. All the merchantable volume on the reproduction plot had been removed eight years prior to this study.

In addition to the plots, a series of supplemental transects with randomly selected snow measurement points were established under each of the several types of cover. The measurements taken on the transects served to check those taken on the plots. A modified Mt. Rose snow tube and scales weighing to the nearest ½ ounce were used to determine the water content of the snow.

Measurements of the snow on all plots were begun each winter at the time of maximum accumulation of the snow cover. The water content of the snow at all established points was measured every other day throughout the period of melting. The area of bare ground was mapped on each plot every fourth day. The water content at the points on the supplemental courses was measured three times throughout the period of melting.

Continuous records of air temperature and wind movement, and daily records of soil temperature beneath the snow and of precipitation, were obtained at climatic factor stations established both in the forest and in the open. These records were secured in order to determine the various weather factors most intimately associated with snow melting.

Results

Snow storage.—The date of maximum accumulation of winter precipitation during the three years varied from as early as March 30 in 1931 to as late as April 6 in 1932. Table 1 shows the depth and water content of the snow and the amount of water lost by interception at the beginning of the melting period each year. Supplemental measurements taken on the transect courses were substantially in agreement with the data shown in this table.

The relative value of the different cover types, considered only from the standpoint of the accumulation of snow, is illustrated by comparing the quantity of snow expressed as water which was intercepted under the different conditions. Except for slight annual variations the water content on the sagebrush plot was practically the same as on the denuded plot. On the reproduction plot an average of 5.4 per cent of the total winter precipitation was intercepted. The high forest canopy of the virgin forest intercepted and dissipated an average of 24.5 per cent, and when a stand of advance reproduction beneath the high forest canopy is added, an average of 29.8 per cent of the total winter precipitation is lost. It is possible that the quantity of interception indicated by this study may be exaggerated somewhat, since the water from snow which may have melted in the crowns and passed down the tree trunks to the soil was not measured. In any event

TABLE 1

SNOW STORAGE AT THE BEGINNING OF THE MELTING PERIOD 1931-1933 INCLUSIVE

Description of plant cover	Average snow depth, inches			Average water content of snow, inches			Comparison of water storage denuded plot used as normal each year Per cent			Annual interception based on av. for 3 years. Denuded plot regarded as normal Per cent
	1931	1932	1933	1931	1932	1933	1931	1932	1933	
Denuded	26.83	42.40	38.05	9.95	17.52	15.03	100.0	100.0	100.0	0
Sagebrush	26.86	44.76	37.46	10.0	18.06	14.84	100.5	103.1	98.7	—0.9
Reproduction	(1)	44.60	36.15	(1)	16.77	14.04	(1)	95.7	93.4	5.4
Virgin timber no adv. repro.	23.76	38.18	34.44	7.25	14.26	10.58	72 9	81.4	70.4	24.5
Virgin timber with advance reproduction	21.89	37.16	34.24	6.35	13.60	9.90	63.8	77.6	65.9	29.8

(1) The reproduction plot established in 1931 was inadvertently destroyed.

this quantity is small, since winter temperatures were rarely high enough to cause rapid melting and accumulation of enough free water to run down the trunks.

An explanation of the fluctuation in the amount of interception from year to year is not apparent from the data at hand. Presumably climatic conditions accompanying and following each storm throughout the winter materially influence the quantity of snow and water which reaches the forest floor. The total annual snowfall does not appear to influence interception to a marked degree. This is evidenced by comparing the interception between years on the plot having virgin timber with an understory of reproduction. In 1931, a year of light snowfall, the apparent interception was equivalent to 3.60 inches of water while in 1932, a year of normal snowfall, the corresponding figure was 3.92 inches of water. In other words, while nearly twice as much water fell as snow in 1932 as in 1931, the interception was increased less than 10 per cent. In a comparison of 1932 and 1933, two years of approximately normal snowfall, it is noted that the interception of 5.13 inches of water in 1933 exceeds that of 3.60 inches in 1932 by approximately one-third, while the total precipitation during 1933 was slightly less than in 1932.

Small openings between trees in the forest were found to be almost, if not fully, as effective in accumulating snow as large open areas beyond the influence of the forest. In order to verify this observation all measurements taken in small openings on both the forested plots and transects were segregated and compared to measurements taken in large nearby open areas. It was found that the average water content of the snow in small openings at the time of its maximum accumulation was 95 per cent of that in openings large enough to be beyond the influence of the forest. Apparently the influence of the tree crowns with respect to accumulation of snow is confined largely to the area directly beneath them.

The influence of the height and size of tree crown on interception was determined roughly by further segregating all points of measurement into groups representing those stations under mature tree crowns and those under crowns of trees younger than 80 years. From this segregation it was determined that the average water content of the snow at the time of its maximum accumulation directly beneath mature tree crowns was 66.5 per cent as great as the average water content of snow in areas beyond the influence of the forest. The corresponding figure for the average water content of snow directly beneath crowns of young trees was 81.7 per cent. A comparison of these two figures shows that the high, spreading crowns of mature trees have a greater capacity to intercept snow than an equal crown area of young trees.

Snow melting.—The comparative rates of snow melting were determined from the measurements of the water content of the snow made every other day throughout the melting season. The average time required for the snow to disappear from each plot is presented in Table 2.

These data show that a dense crown cover has a material influence in retarding the rate of melting of snow. It required approximately eight days longer for the snow to melt on the reproduction plot and the plot having mature timber with advance reproduction as compared to the denuded and sagebrush plots. Melting was retarded on an average of 3.6 days on the plot representing mature forest without advance reproduction. The date of final disappearance of the snow on the plot in the sagebrush was very little different from that on the denuded plot. For the most part the snow which remained in the forest after melting on the open plots was completed, was concentrated on the north side of trees and beneath dense shade. It is significant also that an average of nearly 20 per cent

of the water in the snow at the beginning of melting on the plot in the mature timber with advance reproduction, and 14 per cent of the water on the reproduction plot, still remained in the snow on the ground after melting was complete on the denuded plot; but only 6 per cent remained under mature timber having no advance reproduction. It is evident, therefore, that the young growth exercises the greatest influence in retarding snow melting.

The first bare ground appeared simultaneously on the mature forest with advance reproduction and the reproduction plots, a few days after melting began. Bare ground appeared on the plot having mature timber without advance reproduction a few days later. The rate of recession on the former two plots progressed rather slowly, however, and within 2 to 3 weeks the area of bare ground on each was less than on the latter plot. All snow disappeared from the plot having mature timber without reproduction approximately 5 days earlier than on the other two forested plots. A complete cover of snow was maintained on the denuded and sagebrush plots until near the end of their period of melting; both plots becoming completely devoid of snow within one day after the first bare ground appeared.

It was found from the weather records that both the mean maximum and mean minimum temperatures were approximately 3° F. less at the station maintained in the forest near the plot having virgin timber with advanced reproduction than at the station in the open near the denuded plots. A compilation of hour-degrees of temperature both above and below 32° F., as determined by the thermograph charts for the two stations, showed that there was approximately 9 per cent less hour-degrees above 32° F. and 20 per cent less hour-degrees below 32° F. in the forest than in the open field. There was a little less than one-tenth as many miles of wind in the forest as outside during the period of snow melting. It would seem, therefore, that the influence of the reproduction in reducing wind movement on the ground was a principal factor which accounted for the delay in melting of the snow on the two plots having reproduction, although reproduction also reduced the temperature materially.

Statistical correlations of these climatic variables with water loss on the various plots show that on forested plots 42.7 per cent of the day-to-day variation in water loss, and on unforested plots 52.1 per cent, was accounted for by the fluctuations in temperature and wind movement. According to this calculation, wind movement played such a small part that its influence was almost completely overshadowed by the combined influence of melting and freezing temperatures. Further studies of evaporation from a snow surface within and outside of a forest are required to fully comprehend the relation of wind movement and temperature to water loss.

TABLE 2.

COMPARISON OF TIME OF DISAPPEARANCE OF SNOW FROM EACH PLOT (AVERAGES FOR THREE YEARS)

Description of plot cover	Average time required for snow to melt	Average depth of snow on vegetated plots when denuded plot became bare	Average water content of snow on vegetated plots when denuded plot became bare	Per cent of water originally on each plot remaining when denuded plot became bare
	Days	Inches	Inches	Per cent
Denuded	32.0	-----	-----	-----
Sagebrush	32.3	.71	.25	1.7
Cut-over timber	40.3	4.60	2.02	14.2
Virgin timber (no adv. reprod.)	35.6	1.51	.59	6 1
Virgin timber (with adv. reprod.)	40.3	4.81	1.94	19.7

Soil temperature beneath the snow was found to be constant at each location, and constant throughout the period of melting. The actual temperature was approximately 32¼° F. This result is obvious, since water percolating through the snow and being absorbed by the soil is at the same temperature, just above freezing, regardless of the vegetative cover. Immediately following the disappearance of the snow mantle the temperature of soil at the unforested station rose considerably faster than at the forested station.

Discussion and Summary

Several phases of this study confirm the work of other investigators, and yet the main issue involved, that of coordinating forest and watershed management is presented in a new light. The Wagon Wheel Gap study (1) and studies by Griffin (3) and Jaenecke and Forester (4) in addition to the present study have shown that maximum yields of water can be expected from denuded areas rather than from forested areas. In fact, it appears from this evidence that if ample water storage in reservoirs and lakes were available, if there were no fears of accelerated erosion, and if the values of the forest from the standpoint of recreation and lumber production were of no importance, it would be advisable to destroy the forests on all watersheds. This is never the case, however, because without doubt the maximum value of a watershed is realized only by efficient multiple use management.

Almost all present developments dependent on water resources require a continous discharge from the rivers and streams which furnish their source of supply. Even where effective water storage reservoirs are available, it is imperative that a continuous flow of water reaches the storage basin. Hence it can be said that most irrigation and hydroelectric projects depend upon the duration as well as the quantity of the streamflow. The retardation of the rate of melting of snow by a forest cover is one valuable means of increasing duration of run-off and distributing the peak flow of rivers and streams over a considerable period of time. The fact that a stand of pure reproduction and a comparatively dense stand of virgin ponderosa pine having an understory could retain an average of 14 and 20 per cent, respectively, of their winter's accumulation of water at the time snow melting was complete on an adjacent denuded area may mean the difference between maturing or losing entire crops in an irrigated farming region which relies on a regulated flow of water. A brush cover, while very effective in accumulating snow, is of little value in retarding the rate of melting and aiding in distributing the peak streamflow.

Proper management of forest resources of a watershed in order to produce the maximum yield of usable water seems to point toward stands managed on the shortest rotation economically and silviculturally feasible. This is borne out by the fact that the total accumulation of snow on the reproduction plot was only 5.4 per cent less than that accumulated on the denuded plot, and the rate of melting was retarded approximately 8 days on this same plot. Ponderosa pine cannot be managed on a rotation of 30 to 40 years, the age of the stand on the reproduction plot, but these conditions can be approximated most nearly by managing the forest as recommended above, thus avoiding the high, spreading crown canopy which would result in stands maintained on a long rotation. The effectiveness of small openings in the forest in accumulating snow should be considered in this connection, and forest management largely from the standpoint of water yield from snow should aim at numerous small openings in the stand rather than a continuous crown cover. As stated by Church (2), the ideal forest cover is one honeycombed by "glades" whose extent is so re-

lated to height of trees that little direct sunlight reaches the snow. In addition, the grazing and recreational use of a watershed should be coördinated with forest management, but a discussion of these features is beyond the scope of this paper.

Much further study is required to understand fully the relation of wild-land management to watershed management. However, it is apparent from this study that unmanaged forest lands are not necessarily the most desirable plant cover for watershed protection, and unquestionably judicious use of the forest cover of any watershed can influence greatly its yield of usable water.

References

1. Bates, C. G., and Henery, A. J. 1928. Forest and streamflow experiment at Wagon Wheel Gap, Colo. Mo. Wea. Rev. Supplement 30, 79 p., illus.
2. Church, J. E. 1933. Snow surveying: Its principles and possibilities. Geo. Rev. 23: 529-563. illus.
3. Griffin, A. A. 1918. Influence of forests upon the melting of snow in the Cascade Range. Mo. Wea. Rev. 46: 324-327, illus.
4. Jaenecke, A. J., and Forester, M. H. 1915. The influence of a western yellow pine forest on accumulation and melting snow. Mo. Wea. Rev. 43: 115-126, 1915.

WHEN we talk of a young plantation as being fully stocked we generally mean only that all the original plants are still surviving or that failures have been replaced in beating-up. But it is possible to have an area fully stocked in this sense and yet not fully stocked in another sense, for one does occasionally meet with plantations which, as a result of an excessively wide planting distance, can hardly be described as fully stocked even though all the plants are visible. The ideal plantation should be fully stocked in both senses; the same number of plants should be present as was used in the original planting, and the correct planting distance for the species and the site should have been adopted. Unfortunately, although few subjects have been more widely discussed by foresters in this country, no one yet knows for certain what the correct planting distance ought to be for any species, and until we know something definite about the relations of planting distance with branch growth and the quality of timber we shall always have difficulty, except in extreme cases, in saying whether any spacing is, or is not, the correct one in a particular set of circumstances.—*Quarterly Journal of Forestry* (English).

THE TENNESSEE VALLEY AUTHORITY'S ATTACK ON SOIL EROSION THROUGH REFORESTATION

By GUS LENTZ

Forestry Division, Tennessee Valley Authority

THE control and prevention of soil erosion in the Tennessee Valley is one of the major objectives of the Tennessee Valley Authority. It has such an important bearing on the regulation of streamflow and the protection of navigation and so affects the general welfare of the entire Valley that the T.V.A. has considered erosion control a very important phase of its activities. Two divisions of the T.V.A. are actively engaged in a valley-wide attack on the soil erosion menace.

The Agricultural Division, working through the county agents and the various state extension departments, is advocating such practices as terracing, crop rotation, strip cropping, and the use of phosphates and other fertilizers to hold the topsoil in place, to increase crop yields on good agricultural land, and to help build up permanent pastures. This work is just getting under way in various counties.

The Reforestation and Soil Erosion Section of the T.V.A. Forestry Division is attacking the erosion problem, for the most part, on the sub-marginal land which is not suited to the growing of crops and is not suitable for pasture. The Forestry Division is carrying on its soil erosion control work primarily with the help of the Civilian Conservation Corps camps and by means of reestablishing a vegetative or forest cover on the sub-marginal land.

There are no existing accurate reports on erosion conditions throughout the Valley. A few soil surveys and reports have been made of individual counties, but there never has been a soil survey of the entire 28,000,000 acres lying in the Tennessee River watershed. Extensive reconnaissance, county by county, has been used as a basis for locating C.C.C. camps and for selecting their work areas. The control work by the camps, with the exception of that on land purchased by the T.V.A., has been on privately owned lands. The Forestry Division's approach to the erosion problem is from the standpoint of proper land use. The basic idea is to keep the best land in cultivation, keep a permanent sod on areas too steep for cultivation but still required for pasture land, and restore the forest cover on sub-marginal lands and those too steep for either cultivation or pasture.

By and large, the amount of soil lost from cultivatable land is probably greater than that carried from the sub-marginal lands. Checking this loss from crop land is not primarily a forestry problem, although some of the camps operated by the Forestry Division are building terrace outlets, taking care of the water as a community problem, and where permanent pastures are badly cut up by deep gullies, the C.C.C. boys are building check dams and are plowing in and seeding the banks in order to prevent deeper cutting. The work of the Forestry Division camps, however, has been confined largely to areas having well developed gullies or areas where most of the topsoil has washed away, leaving a barren or "galled" spot supporting little or no vegetation.

This erosion control work at the present time is carried on by 19 C.C.C. camps, located four in Virginia, thirteen in Tennessee, and two in Alabama. Requests for additional camps for Tennessee and Alabama were made as of January 25. These camps are administered by three agencies, as follows:

(1) The T.V.A. Forestry Division, through the Reforestation and Soil Erosion Section, acts in the capacity of a consulting

architect, selecting the work areas, laying out the projects, and inspecting them during construction and upon their completion. Eight foresters and eight erosion engineers carry on this phase of the work. If and when additional camps are allotted to the T.V.A., the number of foresters and engineers for this work will be increased.

(2) The U. S. Forest Service, through the men in the Knoxville office, acts as the contractor. Its function is to select the supervisory camp personnel, furnish the equipment for carrying on the work, and prepare reports on the work accomplished.

(3) The U. S. Army, operating from Third Corps Headquarters for the Virginia camps, and Fourth Corps Headquarters for the Tennessee and Alabama camps, takes care of the housing, feeding, clothing and general welfare of the enrollees. The Army also acts as paymaster to the enrollees and officers.

These three agencies in the Tennessee Valley have worked side by side and are cooperating 100 per cent on all matters pertaining to the work. The fact that each of the agencies has men in authority located at a central headquarters office enables any minor difficulties to be quickly adjusted, and appeals to higher authorities are seldom necessary.

The erosion control technique which has been developed in the Norris Lake region of the Tennessee Valley is somewhat different in its application, I believe, from that generally used on other erosion control projects. This is due, to some extent at least, to the fact that the original work carried on in the Clinch-Powell drainage basin above the Norris Dam had for its immediate objective the prevention of gravel, sand, and silt reaching the Norris Reservoir. With the date of completion of the dam set for January 1, 1936, it was considered essential to have effective means of control installed prior to that time. The steep terrain, the heavy rainfall concentrated during certain heavy showers, and the nature of the soil resulted in long, narrow, V-shaped gullies, with steep side walls. These conditions led at first to the construction of rather permanent and very numerous check dams built of logs, rock, and rock masonry. It was soon found, however, that this method of approach would be a costly one, and that even with nineteen camps, of which 17 were above the dam, we would not be able to accomplish our objective. A change in the technique was made, therefore, with the objective of cheapening the work and making the man-days of work available more effective. The method of control now being used was developed during the summer of 1934. It is not an entirely new plan, but has been adapted from experimental methods tried out at the Statesville, N. C., experiment station of the Bureau of Chemistry and Soils. The present plan of procedure, after the work areas have been selected and an agreement drawn up with the land owner, is as follows:

The forester and the erosion engineer examine the eroded area and prepare plans for the work, the engineer planning such structures as check dams, diversion ditches, etc., and the forester making the plans for reforestation. The engineering phase of the work consists of several methods of attack, depending on the nature and extent of erosion found. In cases where the washing has resulted in the formation of a series of shallow shoe-string gullies, they can be plowed in and the area planted to grass and trees. Where single deep gullies cut through an area, the control method consists of erecting check dams in the gully, plowing in the gully banks, and establishing a vegetative cover behind the dams and on the slopes of the banks. Where the gullies are more numerous, and where extensive "galled" spots occur, the procedure is a little more involved. In such cases, it consists of several steps.

The area of the drainage basin is first determined by a survey, so that the maximum amount of run-off which has to be cared for can be determined. After this

has been done, the T.V.A. erosion engineer and the camp engineer stake out the location of all dams and diversion ditches and indicate where gullies should be plowed in. Both engineers keep check on the work while it is in progress and the T.V.A. erosion engineer passes on it at a final inspection.

After the size of drainage ditches and spillway notches for the check dams has been determined, one gully (in extensive areas it may be more) is selected for the purpose of carrying all the run-off water from the area to be treated. Check dams of log or rock are constructed in this gully, with spillway notches deep enough to care for the concentrated water which the gully must carry.

Diversion ditches, with a base of not less than three feet and with a grade of not over 1 per cent, are then laid out and built so as to carry the water away from the heads of all gullies except the one already referred to.

The gullied and eroded areas below the diversion ditches and the banks of the controlled gully are then plowed in, so that the steep banks are reduced to at least a one-to-one slope and so that a good seed bed will be provided for the grass, legumes, and trees which are to be planted.

The area which has been plowed is next planted to a grass mixture, which during the spring months consists of ten pounds of Italian rye grass, six pounds of perennial lespedeza, two pounds of Korean lespedeza, two pounds of Tennessee 76 lespedeza, two pounds of sweet clover, two pounds of red top, and two pounds of orchard grass. This mixture is sown at the rate of about 26 pounds per acre over all of the area which has been freshly plowed, and along the banks of the diversion ditches.

A light matting of straw or pine or cedar brush is then scattered over the freshly seeded area. In some cases this seeding and matting is done in strips, with alternate strips receiving no treatment, the strips being about twenty feet wide. The purpose of planting grass and legumes is to furnish a protection for the freshly plowed area until such time as the trees, which are planted later, will provide sufficient cover. In cases where the land owner has no objection to its use, Bermuda grass may be established by planting rooted stolons. It is particularly recommended for use behind the dams, where it will spread and hold the collected silt.

The final stage in the control measures is planting the area to such pioneer tree species as black locust, shortleaf pine, Virginia pine, or red cedar, with a scattering of such climax species as yellow poplar, black walnut, various oaks, and in some cases blight-resistant Asiatic chestnut. The black locust is planted primarily in the gullied areas, where spacings from 3 x 3 feet to 6 x 6 feet are used, depending upon the condition of the gully and its tendency to erode. Pines are planted on the areas which have not washed so badly and where some vestige of the top soil remains. Pine is also favored in the sandier sites. Both the Virginia pine and locust are considered pioneer species and are not looked upon as trees which will make up the climax association.

In order to introduce trees of the more valuable climax species, seed spotting of black walnut, Asiatic chestnut, various oaks, and yellow poplar is carried on on favorable sites within the locust and pine plantings. Seedlings of these species are also put out in the more favorable locations which are found behind the check dams or in moist pockets where rich top soil may still be found. Most of the areas to be planted have lost the topsoil, and it would be useless to plant climax species direct. By introducing a few trees of the better species they can be depended upon to act as seed trees, and after a period of time to convert the stand from a pine or locust to a mixed hardwood stand. On some of the eroded areas a volunteer pioneer stand of hickory, persimmon, sassa-

fras, cedar, or pine may be partially established. In such cases the planting which is done is for the purpose of filling in the gaps and for the purpose of introducing trees of the more desirable species.

There are, throughout the Valley, areas on which the gullies are still in the formative stages and where extensive control work such as the placing of matting or the building of check dams is not necessary or justified. On many such areas all that is needed in the way of site preparation is the plowing of furrows along the contours, with a spacing of about six feet between the furrows. The trees are then planted in the furrows, spacing them six feet apart.

Some idea of the extent of the reforestation work carried on this year as an integral part of the erosion control program can be gained from the fact that five million trees will be planted during the 1934-35 planting season. Last season three million trees, mostly locust, were planted. The trees planted this year were grown for the most part in the two forest nurseries at Clinton, Tenn., and at Wilson Dam, Ala. The Asiatic chestnut were grown in the tree crop nursery at Norris. Additional shortleaf and Virginia pine as well as several hundred thousand hardwood seedlings were obtained by digging wild stock on adjoining forested areas. With the further development of the nurseries the planting can be stepped up and all the required planting stock will be grown in the nurseries.

A real start has been made toward erosion control by the T.V.A. Forestry Division on lands not required for crop production. Lands which have been washing away, with gullies getting deeper and deeper, have had the erosion checked and a young stand of trees is coming along to furnish a complete vegetative cover in from three to five years.

THE UNITED STATES NEWSPRINT INDUSTRY AND THE R. F. C.

By ROYAL S. KELLOGG

Association of Newsprint Manufacturers of the United States

Mr. R. S. Kellogg, Secretary of the Association of Newsprint Manufacturers of the United States, stands high as an authority on the statistics and economics of the newsprint industry. His argument is that it would be unsound policy for the federal government, through the Reconstruction Finance Corporation, to extend credit for the development of new plant capacity. From his supporting evidence he points to the conclusion that further expansion of the industry is by no means limited by the supply of raw material, but rather by market limitations; that the sustained yield capacity of the Nation's pulpwood resource is far in excess of public requirements; and, that the installation of a new plant anywhere means the closing down of equivalent capacity elsewhere. This in time would mean a comparable disemployment of labor and no net gain in unemployment relief.

THE recent Act of Congress, extending the life of the Reconstruction Finance Corporation, authorizes the Corporation to make loans to "any industrial or commercial business." The previous requirement that loans be made only to businesses established prior to January 31, 1934, was eliminated so that loans may now be made to new enterprises. The requirement that industrial loans must be "adequately secured" was changed to read "so secured as reasonably to assure repayment of the loans."

Because of these changes in the law it is understood that applications have been made or will soon be made to the Reconstruction Finance Corporation for loans to build pulp and paper mills. The newsprint industry of the United States protests against any loan of federal money for the purpose of creating additional facilities for the manufacture of newsprint paper because

1. Existing plants are unable to operate to anywhere near capacity.

2. The present industry is operating under an N.I.R.A. Code which has substantially increased its production costs. The principal provisions of this Code are those which raised wage rates and shortened working hours. They have been faithfully observed by the industry.

3. The N.R.A. has refused to accept recommendations of the industry for stabilization of conditions under the Code, although these recommendations were drafted in accordance with the suggestions of N.R.A. officials.

4. Under such conditions, it would be the height of injustice for the government to subsidize a new plant and thus give it an unfair advantage over the existing members of the industry.

Newsprint paper is the only kind of paper made in the United States which is now—or ever has been—on the free list. There has been no duty upon it since 1913. With the United States using over 40 per cent of all the newsprint made in the world, and offering a free market for the world production, a discussion of the condition of the industry in the United States is inseparable from that of the world market. This discussion naturally falls into two major classifications, i.e., statistical and economic.

The Statistical Situation

Prior to 1913 domestic production supplied nearly all the newsprint used in the United States. All duty was removed in that year following prior reductions in duty, and the picture rapidly changed. This is clearly brought out in Table 1,

which shows the sources of the newsprint used in the United States from 1913 to 1934 inclusive. In 1913 imported newsprint supplied less than 15 per cent of the year's consumption, and it came practically all from Canada. In 1934 importations totalled 70 per cent of the newsprint paper available for use by United States publishers, and, while the bulk of the importations as heretofore came from Canada, there were large amounts also from four European countries and from Newfoundland.

The table shows in most striking fashion the disastrous effects which importations have had upon the volume of production of the United States industry, despite the heavy increase in consumption. For example, consumption in 1934 was 112 per cent more than it was in 1913, yet the production of the United States newsprint mills was 27 per cent less. In fact, the United States production now has been reduced to approximately the level of thirty years ago.

The relationship of United States newsprint production to world production is shown in Table 2, which covers the years 1927-1934, inclusive. In 1927 the United States output amounted to 23 per cent of the world production of newsprint. In 1934 United States mills made but 13 per cent of the world output. In other words, there was a decrease of 35 per cent in United States production during these years, and an increase of 30 per cent in the total output of other countries. Neither has the limit of possible newsprint production in other parts of the world yet been reached.

The extraordinary falling off in United States newsprint production does not indicate any shortage of paper for domestic publishers. On the contrary, it shows the inability of the United States industry to maintain its position against unimpeded drastic world competition. And this position has been made much more precarious through the increased burdens imposed upon the industry by the Na-

TABLE 1

SOURCE OF NEWSPRINT USED IN THE UNITED STATES
(Tons in Round Numbers)

	U. S. production	U. S. exports	Imports into the U. S. from Canada	Newfoundland	Europe	Available for consumption
1913	1,305,000	43,000	219,000	——	1,000	1,482,000
1914	1,313,000	61,000	310,000	——	5,000	1,567,000
1915	1,239,000	55,000	367,000	——	1,000	1,552,000
1916	1,315,000	76,000	468,000	——	——	1,707,000
1917	1,359,000	94,000	558,000	——	1,000	1,824,000
1918	1,260,000	97,000	596,000	——	——	1,759,000
1919	1,375,000	111,000	628,000	——	3,000	1,895,000
1920	1,512,000	49,000	679,000	1,000	50,000	2,193,000
1921	1,225,000	17,000	657,000	——	135,000	2,000,000
1922	1,448,000	26,000	896,000	——	133,000	2,451,000
1923	1,485,000	16,000	1,109,000	——	200,000	2,778,000
1924	1,481,000	17,000	1,197,000	4,000	156,000	2,821,000
1925	1,530,000	23,000	1,295,000	20,000	133,000	2,955,000
1926	1,684,000	19,000	1,658,000	94,000	100,000	3,517,000
1927	1,486,000	12,000	1,776,000	89,000	122,000	3,461,000
1928	1,418,000	11,000	1,926,000	114,000	116,000	3,563,000
1929	1,392,000	19,000	2,195,000	132,000	96,000	3,796,000
1930	1,282,000	10,000	1,989,000	156,000	134,000	3,551,000
1931	1,157,000	10,000	1,754,000	160,000	151,000	3,212,000
1932	1,009,000	8,000	1,533,000	114,000	144,000	2,793,000
1933	946,000	11,000	1,545,000	95,000	153,000	2,728,000
1934	957,000	23,000	1,956,000	107,000	147,000	3,144,000

tional Industrial Recovery Act.

The United States and Canada form an economic unit in the production and use of newsprint paper. Seventy-five per cent of the newsprint paper made in Canada last year was shipped to the United States. The inter-relations between the two branches of the industry are numerous and intimate. For this reason Figure 1 is particularly illuminating. It shows the theoretical capacity of the United States and Canadian industry in comparison with the actual volume of production since 1917. And the so-called "theoretical capacity" is an actual capacity were the price of newsprint paper high enough to permit all machines to make newsprint paper which have heretofore done so. In other words, there are no machines included in the aggregate of theoretical capacity which have

TABLE 2

NEWSPRINT PAPER PRODUCTION
(2,000 lb. Tons)

Year	United States	Other	World
1927	1,486,000	4,878,000	6,364,000
1928	1,405,000	5,339,000	6,744,000
1929	1,392,000	5,927,000	7,319,000
1930	1,282,000	5,743,000	7,025,000
1931	1,157,000	5,465,000	6,622,000
1932	1,007,000	5,268,000	6,275,000
1933	946,000	5,475,000	6,421,000
1934	957,000	6,343,000[1]	7,300,000[1]

[1]Estimated.

TABLE 3

CONTRACT PRICES FOR NEWSPRINT PAPER,
NEW YORK DELIVERY

Year	Price
1924	$80.80
1925	76.80
1926	71.80
1927	71.80
1928	67.50
1929	62.00
1930	62.00
1931	57.00
1932	53.00 45.00—June 1
1933	45.00 40.00—April 1
1934	40.00
1935	40.00

not made newsprint paper under more favorable conditions than at present, and neither are any machines included in this classification at a higher rate of capacity than their actual production when they were in operation.

Figure 1 shows that the capacity began to run substantially beyond production in 1926; that the widest gap was established in 1932 when the total production in the United States and Canada was at only 52 per cent of the theoretical capacity, and, even with the material comeback in 1934, there was an operating ratio of only 63 per cent for the combined United States and Canadian industry. It is obvious, therefore, that there can be an increase in the volume of newsprint production in the United States and Canada far beyond any total yet attained in the history of the industry before the limit of the capacity of existing equipment is reached.

THE ECONOMIC POSITION

The generally prevailing contract prices per ton for newsprint paper, delivered at New York City since 1924, are shown in Table 3. It will be noted that during the past two years this price has been less than one-half what it was in 1924. In addition, much tonnage is being regularly sold at differentials below the present figures.

The New York price is the port price throughout the United States and thus covers all the principal seaports of the Atlantic, Gulf and Pacific coasts and the Great Lakes. This price, therefore, applies to a large proportion of the total United States consumption of newsprint.

While this $40.00 delivered port price for newsprint is below the weighted average cost of producing all the newsprint paper made in the United States, without allowing one cent for interest upon borrowed money or return upon capital in-

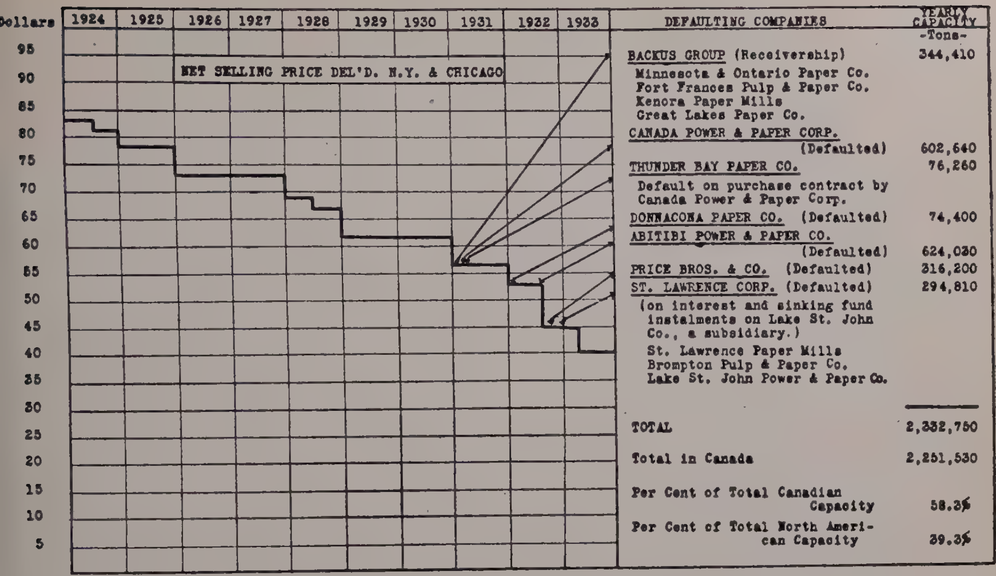

Fig. 1.—The newsprint paper industry, 1917-1934, United States and Canada.

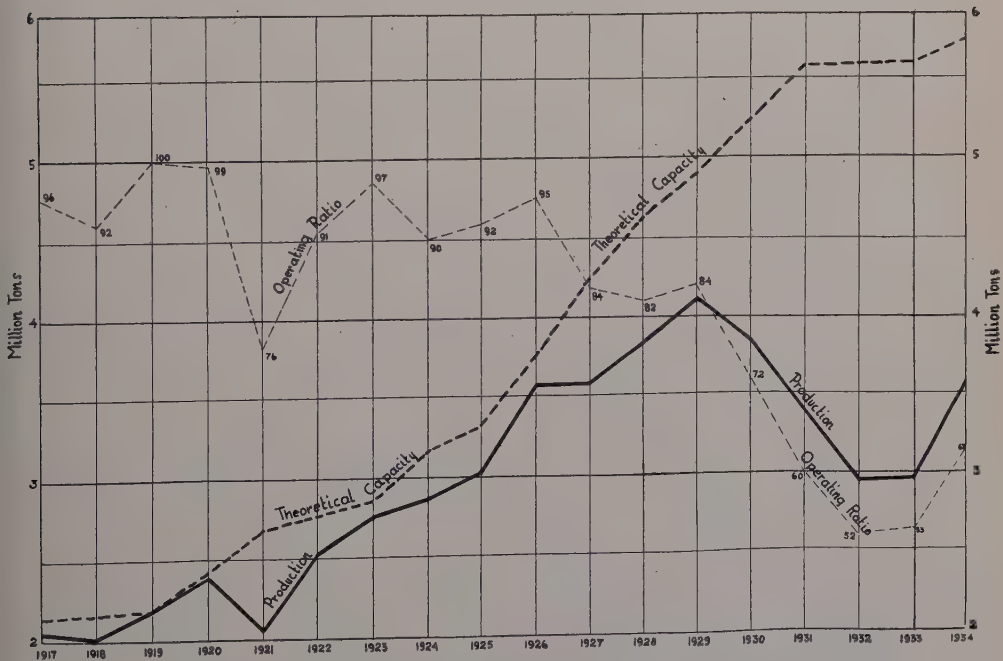

Fig. 2—Effect upon the Canadian industry of the fall in the price of newsprint.

vested, all the overseas newsprint sold in the United States is at differentials of $5.00 to $7.00 per ton below the domestic price. The cumulative result of these conditions is that companies having 58 per cent of the total Canadian newsprint capacity and 39 per cent of the total North American capacity are already in bankruptcy or receivership, or have recently passed through some form of reorganization. Figure 2 shows most graphically this situation. It should be noted that all these companies crashed at a time when prices were substantially higher than today, and that they include five out of eight of the largest newsprint manufacturers on the North American Continent. Continuation of present conditions will inevitably result in further catastrophes of this kind.

It should be remembered that the going into receivership and reorganization of a producing company does not necessarily lessen cut-throat competition in an overbuilt industry. On the contrary, such competition may be greatly increased, because with the wiping out of a large amount of invested capital, through bankruptcy proceedings, the reorganized company may proceed to sell its product at a price which cannot be met by solvent companies without bringing disaster upon them also. In other words, financial reorganization and loss of invested capital does not extinguish physical equipment. Savings and investments may be annihilated but machines remain. They are just as capable of operation as before.

Conclusions

All of the available information—and it is accurate and complete — clearly shows that there is neither any shortage nor the possibility of any shortage in the supply of newsprint paper for use in the United States, so long as there is no duty upon that product. The United States industry has been steadily forced to shift to other grades because it could no longer afford to make newsprint. The same drastic competition has brought bankruptcy to a large part of the Canadian industry, because that industry has a free market in the United States for newsprint only and cannot help itself by grade shifting.

The United States newsprint industry has been forced to assume heavy additional burdens through the increased costs not only of its own direct operations but of all of its materials, occasioned by the National Industrial Recovery Act. It is also being subjected to heavily increased local taxation, with greatly increased federal taxation apparent in the near future. Under such circumstances it would be the height of injustice and economic folly for public money to be loaned to promoters for the purpose of building plants to add to cut-throat competition in an already overdeveloped industry. There is no emergency which justifies any such public action nor any social benefit to accrue therefrom, because if employment is increased through the building of new plants by this means, it will just as surely and proportionately decrease existing employment in old-established plants and communities.

THE LUMBER CODE SITUATION

By JOHN B. WOODS

At the annual meeting of the Society of American Foresters in January a half-day session was devoted to presentation and discussions of papers on Article X of the Lumber Code. Since then much has happened to affect the orderly progress of events. Mr. Woods, Chief of the Department of Forestry of the Lumber Code Authority, takes this as his first opportunity to sum up the situation, as it existed on May 7.

MORNING papers on March 26, 1935, carried an announcement that the Government would ask for dismissal of its appeal before the Supreme Court in the case of United States v. Belcher.

The Belcher Case involved admitted flagrant violations of wages and hours provisions of the Lumber Code by an Alabama manufacturer, for which he was indicted in the spring of 1934. The District Judge sustained a demurrer to this indictment on the ground that the Recovery Act was unconstitutional and that approval of the Lumber Code was beyond the President's powers and that the Code, therefore, was legally void.

The N.R.A. and the Department of Justice selected this as an ideal case to test the constitutionality of the National Industrial Recovery Act and an appeal was taken direct to the Federal Supreme Court. It was stated, and generally understood throughout the country, that the validity of the wage and hour provisions of the Lumber Code (and all other codes), was to be established by the decision of this case. It was further understood that after such a decision, the enforcement of wage and hour provisions would go forward vigorously and impartially. From the standpoint of national recovery, the heart of the Lumber Code, as of other codes, is in its wage and hours provisions, and enforcement is a vital necessity. If the willing majority are to pay Code wages, the unwilling minority must be compelled to do so. Action to enforce the Code has been the duty of N.R.A. A decision of the Belcher Case has been acknowledged as the first objective. After months of preparation the Government suddenly declined to face the issue.

In the language of the Department of Justice press release the reasons were as follows:

"The case arises under an indictment charging violation of provisions of the Lumber and Timber Products Code. . . . This Code contains administrative provisions peculiar to itself with respect to the extension of discretionary powers to non-governmental agencies—a fact. . . . which sets this Code in a class by itself. Revision of this situation is . . . . now under consideration by the National Industrial Recovery Board. In any event, this feature is expected to be eliminated under the new legislation recommended by the Administration. A further unsatisfactory feature in this case is that, due to the nature of the action, no findings could be made by the lower courts. . . . Other cases in which these objections do not exist are being pressed in several of the Circuits in order that decisions of the Appellate Courts may be secured as soon as possible."

In view of the fact that the unique provisions of the Lumber Code now found objectionable had been written by the N.R.A. and accepted by the industry and the further fact that both Code and Constitution were the same on March 26, 1935 as when the Belcher Case was selected for a test, the reaction to this announcement was a mixture of confusion and despair. This was intensified by the further declaration by the Department of Justice:

"Meanwhile and pending desirable

amendments to the Lumber and Timber Products Code, there will be no relaxation in enforcement of other codes."

This was to say by inference that there would be no further enforcement of the Lumber Code in its present form.

While technically, the Code remained in effect, actually the proposed action by the Attorney General withdrew from the lumber and timber products industries the hope that N.R.A. would redeem its promise to enforce their Code. Persons under the Code had long been in an impossible situation, forced to choose between violating the Code and being ruined by the competition of violators. Now they were being told that their Code was unenforceable: Therefore if they obeyed Code law they possibly were violating the anti-trust laws. Whatever they did might be criminal.

The action taken by the Department of Justice had been dictated by highest authority and officers of N.R.A. were frankly chagrined by the turn of events. In an atmosphere charged with uncertainty representatives of the Code Authority and the Recovery Board agreed to avoid ultimatums and began a series of conferences to ascertain what might be saved out of the crash.

Responding to a telegraphic call authorized agencies of the Codes representing a substantial majority of the industry expressed the belief that in the absence of enforcement support the Code is intolerable and should be suspended. However, formal application for such suspension was withheld pending the results of conference.

Representatives of N.I.R.B. stated that compulsory enforcement of the Code will not be undertaken during continuance of conditions making it inequitable, but that government contracts will continue to be awarded upon basis of voluntary compliance. They promised to prepare and submit to the industry appropriate amendments to cure alleged defects and proposed that when any Code Division or Subdivision assents to such amendments they will become effective therein and that when such course becomes equitable the greatest possible degree of compliance and enforcement effort will be exerted in behalf of each Division and Subdivision. They further offered to set up a special Board with authority to deal promptly and effectively with the affairs of the Lumber Code.

Industry's conferees, the National Control Committee, submitted the Government's proposals to the Divisions and Subdivisions for their consideration. The next step in getting the true picture before the industry was to hold a meeting of the full Code Authority in Chicago late in April, at which the program was discussed and ordered referred to the industry, to be reported upon by Divisions and Subdivisions at the regular Lumber Code Authority meeting in June.

In the Congress, the Senate Finance Committee has been holding hearings upon N.I.R.A. for several weeks. The President's proposal to extend the Act two years was introduced in the Senate on March 29, and aroused a conflict in Committee that terminated for the time being in a compromise proposal to extend the Act with certain modifications to April 1, 1936.

Meanwhile the Department of Justice has moved to face the issue of constitutionality by asking the Supreme Court to decide the case of U. S. v. Schechter Poultry Corporation. Arguments were heard May second and third, and possibly a decision may be had before the end of the month. Further action by Congress before the Supreme Court decides is considered extremely unlikely.

The industry's response to the National Control Committee's appeal for voluntary compliance has been remarkable. All of the larger Divisions and most of the

smaller groups have carried on. Due to reduction of Code fees and the anticipated difficulty of collecting such fees even on a reduced basis in the absence of any hope of Government enforcement support, the L.C.A. staff personnel was drastically reduced and much of the field inspection work in the Divisions was discontinued.

Article X being one of the most significant provisions of the Code, there was immediate and widespread expression of anxiety throughout the country as to what would happen to the conservation set up. The Society of American Foresters as spokesman for the forestry profession and as a public agency which had contributed largely to the formulation of forest practice rules made immediate inquiry about the status of conservation administration, and was promptly assured that whatever the fate of the Code might be, some means would be found by the organizations representing the industry to carry forward the work organized under Article X of the Code to assure sustained production of forest resources.

As is generally understood, those administrative agencies of the Lumber Code, having jurisdiction over primary manufacture, and therefore being responsible for forest conservation, are in fact trade associations, with a membership backlog of leading manufacturers who not only support the Code but value as well the extra-code advantages of associated effort. It is believed that such associations will exert every effort to continue and expand the conservation activities begun under the Code, regardless of the decision of the Supreme Court or the action of Congress.

On March 26 the industry personnel engaged in carrying forward Article X work numbered 26. Today they number 23. Most of the Associations have made formal statements of their determination to carry on. There are manifest advantages to the Code set up that are particularly valuable to such an enterprise as the national conservation program. Not the least of these is the fact that it is law, and as such free from the play of varying opinion as to its importance in the scheme of things. Under purely voluntary administration there may be a loss of uniformity of effort and progress; some regions will push forward under the leadership of aggressive conservationists while others may find it necessary to pause from time to time to re-educate their people.

Undoubtedly something must be done soon to bring into the conservation set up the myriad small woods operators now not under the Code. Tentative plans are formulated for doing this if the N.R.A. is extended. If the N.I.R.A. is permitted to expire an entirely new approach to this problem will be required. The period between now and June 16 will witness events of gravest importance to forest conservation, but the industry now under the Lumber Code will do its part to meet whatever situation develops.

In connection with the preceding article, it is appropriate to publish here the text of two letters interchanged between the Executive Secretary of the Society of American Foresters and the Secretary and Manager of the National Lumber Manufacturers Association.

On April 8, 1935, Executive Secretary Reed wrote to Dr. Compton:

"On behalf of the Society of American Foresters, I wish to emphasize the extreme importance to the country of the continuation by the lumber industry of its systematic and determined effort to effectu-

ate forest conservation.

"I am advised that the lumber code may be suspended; but this, the Society feels most strongly, should not be allowed to interrupt the progress of private forestry.

"The Society, through its membership, individually and collectively, has contributed to the Article X enterprise. It will continue to support that effort in whatever proper form it may take."

In reply, Dr. Compton wrote, under date of April 9:

"The future of the Lumber Code is known to be uncertain. If for any reason the Code is not continued, or if the Code Authority is not able to continue its administration of the Code, including the forest conservation provisions, it is the intention of the National Lumber Manufacturers' Association, as the original sponsor of the Lumber Code, to continue the forest conservation work, to seek the cooperation of the industry associations, and to seek needed public cooperation. In any event, the development of the forest conservation work within the industry and the effort to encourage sustained yield forest management will be continued.

"I trust this will answer your letter of April 8.

"The successful conduct of the activities and responsibilities undertaken by the industry under the conservation code is known to be dependent largely upon the nature and extent of public cooperation. This has been recognized by public and industry agencies alike. The public cooperation in its promised forms is expected to include forest tax reform, forest protection, forest credits, research, timber acquisition and aids to sustained yield forest industry operation.

"In the absence of substantial public action in these directions, it is of course not to be expected that progress will be satisfactory nor adequate either from the public or the industry point of view. These purposes evidently must await federal and state action. Principal forest land owners, however, have not waited and are not waiting. The industry agencies are doing the best they can and will so continue. The conservation problem and undertaking are permanent, not emergency, and should not be interrupted."

AN ANALYSIS OF IMPROVED FOREST PRACTICE ON WESTERN PINE OPERATIONS UNDER THE LUMBER CODE, WITH SUGGESTIONS FOR PERMANENT NATIONAL ACTION

By C. S. MARTIN

Western Pine Association

THE purpose of this analysis is to present as accurate a picture as possible of a cross section of the western pine industry as affected by the operation of Schedule C of the Lumber Code during the first ten months of its application. It was felt that a picture of what is actually taking place in woods operations would be of value in appraising the practical worth of Schedule C, would show the weakness and strength of its provisions, and possibly would indicate the share private industry should assume in giving effect to a broad national policy of conserving the timber resources of the country.

In order to make the statistics truly representative, they were taken directly from the reports of district forest engineers which had been submitted on a confidential basis in the course of their routine Code work from May, 1934, to April, 1935. The 49 companies reported on were those whose operations had been covered a number of times during the period for one reason or another—some because compliance was difficult to secure, some because they were particularly anxious to work out their forestry problems, and others where repeated visits were the result of chance, headquarters inspections, and filling in rounds of field trips.

These operations are located in the pine areas of the three far western states, Washington, Oregon, and California. They include the largest and the smallest operations, from an annual outturn of 88 million feet of lumber per year to one of 25 thousand board feet, from companies owning more than 400,000 acres of timber land to those buying their timber forty acres at a time, and from elaborately equipped machine operations to those where an old truck plus horse and manpower comprised the logging outfit.

The presentation of this material is attempted from an entirely detached viewpoint, as that of an observer close to the problems involved, familiar with both technical and practical considerations, and seeking a sound approach to the national need of a permanent forest policy.

The 49 companies are classified as "small" (production under 3 million feet per annum), "medium" (production over 3 million feet and under 30 million feet per annum), and "large" (those producing over 30 million feet per annum).

There are 13 "small" operations, 25 "medium" operations, and 11 "large" operations.

The forested land owned or controlled by these companies is 1,448,780 acres; their combined normal production of 855 million feet per annum divided as follows:

"small" group—12 million feet
"medium" group—328 million feet
"large" group—515 million feet

Two of these operations are now on a sustained yield basis, with a permissible annual cut over the first rotation of 73 million feet.

Seven others are so situated that their operations could be worked out on a sustained yield basis. Their combined capacity is 280 million feet.

Thirty companies have a prospective life of approximately 10 years. Their annual production amounts to 200 million feet.

The remaining 10 operations have a prospective life of at least 20 years. Their annual capacity is 282 million feet.

If this cross section of the industry is at all representative, and I believe it to be so, then this grouping gives us at least an indicative picture of the trend of the western pine industry. Forty-one per cent of the capacity is so situated that individual sustained yield management plans could be worked out as soon as a revision of methods of taxing standing timber is secured and long time credits at low interest rates are assured. Thirty-three per cent of the capacity, now on a liquidation basis, still has enough timber available to work out an orderly policy, either combining with other companies or supplementing their holdings with public timber for the purpose of sustained yield management or adjusting their zero margin cutting limits to a 20 year basis. The remaining 26 per cent of the capacity has little alternative but forced liquidation, hurried by the pressure of creditors and often regardless of an adequate return on the investment. It is this class of operation that continually upsets the price structure and creates unsound competition by often selling the product far below a cost basis. The weaker companies, forced out of business, sell their plants for a few cents on the dollar, and again unhealthful, uneconomic competition sets in. This was one of the sore spots that it was hoped could be corrected through Code organization.

From the points noted above, we might conclude that approximately 74 per cent of the western pine industry can eventually be managed on a sustained yield basis, and on a regional basis our pine forests will sustain that percentage of the production. The remaining 26 per cent capacity should be retired as quickly and painlessly as possible.

With proper laws we should be able to place the 41 per cent under sound forest management within five years. The remaining 33 per cent will require a great deal of readjustment in the form of mergers, change of location, and the formation of economic sustained yield units based more on permissible yield than on individual ownerships. To accomplish these changes, including the retirement of obsolete and poorly managed plants, will require not less than ten to fifteen years.

In other words, if we can have the West on sustained yield by 1950 we can feel that a good job has been done. To expect more than can possibly be accomplished under existing circumstances will only lead to disappointments. We do, however, need a definite 15 year plan, to be worked out in five year cycles, with necessary revisions at stated periods. Only then may we adequately measure each year's accomplishments.

After this short look ahead at future possibilities, it seems apropos to make a brief survey of accomplishments under Schedule C of the Lumber Code since June 1, 1934.

Going back to the reports on these 49 companies, we find that 47 of them, with a capacity of 847 million feet, are generally complying with the Code. Two companies, with a yearly outturn of 7,900 M feet, 0.93 per cent of the total, have refused to comply with Code requirements. One of them, however, cuts no trees under 16 inches d.b.h., and the other is interested in zero margin diameter limits, so some progress has been made with them.

Fifteen of the companies in Oregon and Washington, where a 13 inch diameter limit has been adopted in the forest practice rules, do not cut any trees below 16 inches d.b.h.

In Oregon, on the lands of fourteen of these companies, where a check has been made on slash disposal, it was found

that 62 per cent of the debris had been burned and only 21 per cent of the ground surface run over. This included one very hot fire that burned 95 per cent of the slash and covered 51 per cent of the ground surface.

Four of the companies voluntarily pile and burn the slash along roads and railroads to cut down the fire risk.

We find that out of these 49 companies under consideration, 23 are interested in making logging and mill studies on their lands; 22 companies have shown a marked improvement in their forest practice since the code came into effect. This does not include the larger, more progressive operations, where the methods are generally in advance of minimum code compliance; it refers rather to those where improvement was most needed.

For all of the companies under review, we find an average reserve stand of 2,000 feet of merchantable timber being left on the land and 2 plus seed trees per acre. While this is not as heavy a reserve stand as is desirable, it must be remembered that this represents only the first few months of effort among hundreds of operations. That they have stopped devastation, are taking much more care in protecting the lands from fire, and are leaving them productive, is really a tremendous advance over past conditions.

It is difficult to refrain from proceeding to sketch the industry plans for improving on present conditions, but that has no place in an article of this kind. I will therefore confine myself to a few suggestions concerning desirable policies which would tend to maintain and build upon the existing foundation of good will and active interest in better forest management on private lands.

1. The first essential is that we foresters must be able to sell forestry management to operators and timberland owners. By "sell" I mean that we must convince them that they can stabilize their business through forestry and at the same time make profit on their operations. If forest management will not make some return above the cost of operation, it cannot be practiced by private capital. Without changes in tax laws and long time financing at low interest rates, there are few holdings existing in the West today that can adopt sustained yield as a business policy. There are some, but not many. It is perfectly obvious that the government cannot acquire and operate all forest lands at this time. It could only do so through complete socialization, and we are not yet ready for that. Regulation alone cannot bring about universal sustained yield. Possibly it can stop or check overproduction, but unless based on sound economics it cannot even do that. Therefore:

2. What can be done to (a) permanently stop devastation, (b) keep forest lands productive, and (c) encourage the adoption of forestry principles in the management of privately owned woodlands?

The first two questions can be answered by more intensive fire protection through federal cooperation under the Clarke-McNary law, by strengthening state laws and enforcement organizations, and by encouraging and increasing the effectiveness of the forest protective associations and of individual operators, plus an intensive effort to educate the public as to its responsibilities in preserving the forest wealth of the country. Recent studies show that the public is responsible for from 70 to 80 per cent of all forest fires.

All agencies should have their part in this drive to control forest fires.

The federal government through financial cooperation, research and experiment, as well as more extension work in education.

The states by building up and support-

ing strong permanent forest departments.

Timber holders, through their protective organizations.

Operating companies, through their associations.

The answer to (c) does not lie in intensive and detailed regulation. It can be more rapidly advanced by actual demonstrations of sound forest management on National Forests, Indian reservations and state forests by the gradual acquisition by the above agencies of all sub-marginal forest lands; by a large increase in cooperative research in problems of forest management by experiment stations and research laboratories, with much more emphasis being placed on research to solve definite problems of utilization and extension of markets for forest products than has been the case in the past.

In addition to these public efforts, the lumbering industry should, through its regional associations, undertake a definite program of protection and research fully integrated with the efforts of public agencies. This should be carried out by means of the divisional organizations already created and functioning under the Lumber Code, their work to be coordinated by a "National Operators Council on Conservation," functioning as part of the National Lumber Manufacturers' Association.

This is not, of course, a new suggestion, as Prof. Recknagel and others have already made much more detailed proposals. But the time has come, I believe, to keep hammering at the matter until something is done about it.

If we delay, we will miss an opportunity that may not come again for another half century.

THE clearest case in which tidiness is a vice is the removal of woody litter from the forest floor. When young plantations are brushed up or when thinnings are cut a lot of untidy litter is left on the ground. Through excess of zeal the woodmen on some estates carry this litter to the edge of the plantations and burn it. The soil is thereby deprived of its most valuable mulch; for mouldering wood is a very useful manure.—*Quarterly Journal of Forestry* (English).

THE USE OF VERTICAL AERIAL PHOTOGRAPHS IN FOREST MAPPING AND TIMBER ESTIMATING

By JULIAN E. ROTHERY

The great use of aerial pictures in forest surveys is not as highly appreciated among foresters as their value warrants. With their increasing availability, methods of mapping and timber estimating are being radically changed. The following outline of this new development was given in a talk at the Yale School of Forestry, February 22, 1935. While it is based on the use of pictures in the northeastern spruce region, they have a wide application to other forest regions as well.

THE development of aerial photography has produced fundamental changes in the methods of forest mapping and timber estimating.

Aerial photographs are now available at reasonable costs from either government or private sources. The following brief resumé endeavors to outline the use of such pictures once they are at hand, together with the simple equipment required, in order to obtain results from them which are within the range of accuracy and cost recognized for forest work.

Let us start with the delivery of a series of vertical contact prints of an area of 100 square miles, whose exterior boundary is well controlled by previous ground surveys. The prints should be of a specified scale, preferably about 800-1,000 feet to the inch, and are most useful if taken in early spring or fall, in order to differentiate more clearly between the conifers and hardwoods. The camera should be calibrated so that the optical center of the lens will appear as a small cross line on each print. The prints must have a fore and aft overlap, along the line of flight of 60 per cent, and also a 20 per cent lateral overlap, or possibly more. A flight or index map showing the relative position of the prints and their serial numbers should accompany them, and it is a great convenience to have the numbering show on the front of the pictures.

Because our pictures have an overlap in the direction of flight of 60 per cent, it is evident that in any three adjacent prints the center points of the outer pictures as distinguished in those prints can also be identified near the fore and aft edges of the middle print. These points should be closely determined, either in relation to some topographic or photographic feature or by the use of the stereoscope, and plainly marked on the middle print. We must in addition select and mark on each print three or more secondary control points along the outer edges of the prints and at right angles to the line of flight, thus making nine or more points roughly arranged in the form of a rectangle showing on each print. The center and rear of the three center points now shown on the middle print are common to the picture immediately aft, and the center and fore point to the picture immediately ahead, while a number of secondary control points will also be shown in common on the adjacent prints.

Vertical photographs are angle true, that is, the angles measured on the photograph between the central point and any other points are true or equal to the same angles measured on the ground. If our first photograph starts at a known point of control and includes easily identifiable landmarks in the same plane, such as occur along a lake shore or a fairly level road or railway, and the distance between these is ascertained, we establish a scale for the print. Thus we

can develop what I may call a series of aerial back sights, which will allow us to construct on tracing cloth placed over the pictures a traverse, based on the center or principal points, which can be adjusted to the ground control framework, established in advance for the area, with a high degree of accuracy.

Errors and inaccuracies due to the side drift of the airplane, or "crab" as it is often called, to tilting of the machine while in flight, and to changes of elevation of the plane while flying, have been so reduced by better technical control that they seldom require correction in compiling a forest map of ordinary size and accuracy. Change of the ground elevation, however, does of course bring in a change in scale and lineal displacements of the points, though the center points still remain angle-true in reference to each other, and the secondary points in reference to the center points.

As a practical matter, however, this displacement is again limited by the fact that, due to the liberal overlap, it is only necessary to work with the central portions of each print—a relatively small area where displacement is minimized. However, on flights where the distance between good ground control is more than six or eight miles apart, even in a fairly level or only gently rolling country it may be necessary to correct the accumulation of errors, due primarily to the change in the ground elevation.

This can be accurately done by the system of radial plotting, developed by Major J. W. Bagley of the U. S. Army and fully set forth in the comprehensive work entitled Surveying from Aerial Photographs by Capt. H. Hotine of the British Army. It is a rather intricate process to describe, but we may grasp its theory when we remember that the 60 per cent overlap has allowed us to mark two identical principal points and a number of secondary points on each of two adjacent prints.

By graphic plotting on tracing cloth, superimposed on a series of prints, we can relocate the points given in the second print on the scale of the first print and continue on, relocating the points of the third from those of the second print throughout the entire flight's strip. The process may be somewhat likened to carrying forward a plane table survey. The result of this is to render on the tracing cloth or paper a principal point traverse for the entire flight, brought to the scale of the first print. The scale of this first print, it will be recalled, was determined from actual ground measurements of known points in the same general plane. This principal point traverse can now be brought to the actual scale as determined by the control survey of the area and adjusted and tied to this framework accurately. A series of these principal point traverses forms the basis of our aerial map, and detail is rendered usually by graphic methods, which depend on the fact that the angles in the photograph are always true.

This is but a brief outline of the underlying theory of radial plotting. Practically there are various shortcuts, such as projecting photographs to scale on a satisfactory base map, where control is good but where details are lacking, or by matching topographic features to form a series of traverses. Such shortcuts will cheapen the cost of work materially, and depending on our control and the adjustment of errors before they are carried forward and accumulated, give results well within the limits of accuracy usually required for forest work.

The examination of prints under the magnifying stereoscope is a study in itself, but I will emphasize one feature of greatest importance: topography and heights of land stand out in unbelievable clarity, and we can render on our map

these divides and determine the area of each watershed with astonishing accuracy. Where river transportation is involved, as is common throughout the Northeast, the determination of the major and minor watersheds is one of the most important factors, as it largely controls logging.

If we have now constructed our topographic map and set forth the watersheds and compartments essential to logging, it remains to portray on it the required type classifications. All of this forest data is very clearly shown under the magnifying stereoscope. Barrens, waste, burn, hardwood, coniferous types, mature and second growth, all stand out in astonishing detail. It will be necessary to reduce the scale of the pictures to that of the map, which is usually 4″=1 mile, and transfer this timber data to the latter. A simple reducing projector, making use of an ordinary photographer's portrait lens and suitable illumination, can be constructed at small cost. With such a projector the prints may be brought to the scale of the map and the outline of the types, previously marked on the prints, projected on the map, where they can be suitably delineated.

The forester then enters the field with an execllent topographic map on which all the recognized types are clearly outlined. Furthermore, he has a set of contact prints keyed to the map, actual photographs of these types, with a scale ratioing the photos to the scale of the map and with the north point shown on each print.

Under the magnifying stereoscope, which is quite practical to carry in the field, all timber and topographic details are clearly brought out. Little map work is necessary, only the correction and refinements of type areas, and no base lines are required. The cruising party study the prints and learn to identify and compare the types and other details, as shown in the photographs, with these objects as they actually occur on the ground. The area of waste is known, and the timber survey consists largely of making sufficient plots and measurements in the different type areas and gathering logging and other data. Barren or valueless areas need not be entered at all, the time being entirely expended in the direct measurement and other work required, with the result that more accurate and detailed information is obtained in a far shorter time, and under many conditions at much less cost.

This is but a glimpse of this new field of the use of vertical pictures for forest mapping and timber estimating. Much work awaits to be done in the use of oblique photographs, infra red photography, high altitude pictures, and a host of other intricate and interesting problems. For the forester, however, simple methods and equipment are sufficient to give the accuracy required. The complicated and costly plotting machines in use in Europe and a few places in this country, while rendering marvelous results, are not necessary for ordinary forest work. Without them, and with only a few hundred dollars' worth of instruments, the forester today has at hand one of the most effective aids in the practical study and analysis of forests yet devised.

If the wise use of natural resources is dependent on readily available and accurate knowledge concerning them, then for our lands and their forest cover, for our rivers and streams and their catchment basins, and the transportation links which bind all these into an integrated whole, the present value of aerial photographs is great, and the future field holds promise of even greater value.

PUBLIC VALUES IN CUTOVER TIMBER LANDS

By G. A. PEARSON

Southwestern Forest and Range Experiment Station, U. S. Forest Service

The question has been raised of the relative "social values" of timberland in the Southwest for stock raising or timber growing. Timber growing shows marked superiority, whether measured by gross financial returns or by volume of labor employment. Eventually, the logical course will be to merge private cut-over lands with the national forests, but by leaving their lands in reasonably productive condition owners can realize nearly full grazing returns, while also building up future timber values. Cutting to a minimum usable diameter limit actually lowers the net profit of the operation. Since destructive exploitation is of doubtful benefit to the owner and detrimental to the public interest, the public is warranted in demanding that it be stopped.

WHEN the rules of forest practice for the Southwest were being formulated under Article X (now Schedule C) of the Forest Conservation Code, several timber operators took the position that their lands have a higher "social value" for stock raising than for timber growing. By social value is meant the total benefit to the community, including taxes, business, and employment resulting from the use of the land. Reasonably satisfactory rules, from the standpoint of forest conservation, were adopted; but one company, taking advantage of Section IX (2), which provides for clearing "larger areas" for other uses, has since been granted a modification of the rules, which, though providing for seed trees, omits all restriction as to present or future cutting of ties, mine props, and stulls, in a locality where these products find a ready market in normal times. The idea that forest lands have greater economic possibilities for grazing than for timber production is not new, nor is it peculiar to the Southwest. If true, it is entitled to more specific recognition than it has received in the national scheme of forest conservation.

Livestock production has been one of the mainstays of industry in Arizona and New Mexico since the earliest settlements by white men. At least 90 per cent of the land is or has been used for grazing. All but a few communities have derived a substantial part of their income from livestock. Saw-timber forests, on the other hand, occupy only about 7 per cent of the total area of the two states. Most of the lumber cut has been concentrated in a few communities. The wealth derived from livestock has been more widely disseminated than that produced by forest industries. Nevertheless, before anyone proposes converting accessible timber lands into grazing lands exclusively, as a measure of public welfare, he is advised to compare possible returns from the two industries.

Attainment of the maximum productive value of any land naturally calls for efficient use of that land. Both range and forest in the Southwest have deteriorated as a result of overuse; this is true more of the range because forage has been more extensively exploited than timber. Up to 10 years ago, pine lands in the national forests of Region 3 were stocked at a yearly rate[1] of 40 to 50 acres to a cow or four sheep. Deterioration of the range due to

[1]Livestock are seldom allowed in the pine forests outside of the summer and fall seasons, but annual carrying capacity is usually figured on a 12-month basis. Thus, a carrying capacity of 50 acres to the cow means that actually the 50 acres support 2 cattle 6 months, or the equivalent.

excessive numbers of stock, poor distribution, and other abuses necessitated heavy reductions in order to control damage to young trees and to the range itself. At the present time, 70 acres per head is about the average figure for mature cattle, and roughly one-fourth that acreage for sheep. At $1 per head as the average yearly grazing fee for cattle,[2] the national forests derive a revenue of a little less than 1½ cents per acre from grazing on pine lands. Perhaps the grazing fee is too low; but organized stock interests in the past decade have several times won their demands for a temporary lowering or remission of the present fees, on the representation that they were unable to pay them. The same land under Forest Service management will grow timber at a rate of from 60 to 100 board feet per acre annually, worth, at $2.50 per M for stumpage, anywhere from 15 to 25 cents an acre. To obtain such yields will require a growing stock of from 2,000 to 3,000 board feet of thrifty young timber per acre. On areas subjected to clean cutting, fire, and overgrazing the timber increment falls to almost nothing; and if overgrazing continues the yield of forage also declines. Under good management, a considerable amount of grazing can be had along with the growing of timber, and thus the total revenue is that derived from timber plus grazing.

Since the bulk of both range and forest products in the Southwest is shipped out of the community where produced, a rough measure of local social values is furnished by the f.o.b. selling price. In one case it is the gross returns to the producer from the sale of cattle, sheep, and wool, and in the other the gross returns from manufactured lumber. At prices prevailing before the present depression, the 70 acres required to carry a cow yearlong would produce beef valued at $25 to $30, or four lambs which with the wool clip would bring about $32. These figures represent in the aggregate the social values of grazing. The same 70 acres after conservative cutting, assuming the low annual increment of 60 board feet, will produce annually 4,200 board feet of lumber, selling at $28 per M f.o.b. and thus representing a social value of $117.60. If the land is clear cut and managed for maximum forage production, the above livestock returns might be obtained from 50 acres; applying equally high standards of forestry, the annual yield of the same 50 acres would be 5,000 board feet having a f.o.b. sale value of $140.

It may be argued that grazing yields a yearly cash return, while timber returns come only after enough volume has accumulated to warrant cutting. The answer is that, if a large tract of timber is managed for sustained yield, a portion of the area may be cut each year, and thus there will be a more or less constant annual return.

Considering employment, we find much variation in both industries, but always a wide margin on the side of timber. Large cattle outfits employ a man to each 300 or 400 head, but small owners may devote the major part of their time to 200 head. If the herd is smaller, it usually means that livestock production is combined with farming or other activities. An average estimate for sheep, including extra help at lambing time, is between 2 and 3 men to a thousand ewes and their lambs. On the side of timber, figures compiled by the Office of Forest Management in Region 3 give the labor consumed in logging, transportation, milling, and selling lumber as 3 man-days per thousand board feet f.o.b. the mill. The labor item runs higher in small operations, and still more so in hewn tie, stull, and prop operations.

Assuming the high carrying capacity of

[2]Grazing fees and credits vary according to local conditions. The gross fee for cattle in Region 3 averages $1.70 per head on a 12-month basis. A credit averaging 70 cents per head is allowed for development and maintenance of range improvements by the stockman, and thus the price paid for the forage amounts to about $1 per head.

50 acres per cow on clear cut land, and assuming that as few as 200 cattle might furnish yearlong employment for one man, the 10,000 acres required to carry this herd would provide approximately 300 man-days of labor. If sheep are grazed instead of cattle, the number of man-days may be from 700 to 900. The same land under good forest management on sustained yield would furnish 3,000 man-days of labor in converting the annual increment into lumber. Even under extensive management, yielding only 60 board feet per acre, the employment would be 1,800 man-days. To these figures could be added substantial items for cultural operations designed to increase yields and for secondary forest products such as ties, stulls, props, and fuel. As has been pointed out, a considerable amount of grazing is usually possible along with timber production, and would contribute to the total employment.

The foregoing are the broad facts from a public viewpoint, as applied to large bodies of public land such as the national forests. In dealing with privately-owned lands, additional factors are introduced. The private owner has an investment in land and stumpage on which he must pay interest and taxes. If he has sold the timber rights to an operator, it merely means that a part of the burden has been shifted to other shoulders. The operator has an investment in logging and milling equipment, as well as stumpage. Theoretically, the government also has an investment in land and timber, but these items do not represent a cash outlay. A primary essential in forestry is continuous operation made possible by sustained yield on cutover lands after the supply of virgin timber has been exhausted. Few if any private holdings in the Southwest are large enough to support a continuous economic timber operation. If the owner leaves the large volumes of growing stock necessary to obtain a high increment, he is confronted by the prospect of frozen assets. The national forests are already organized on a sustained yield basis. The factor of deferred returns does not enter, because the government has vast holdings of mature timber which can and should be cut while a crop is growing on cutover lands, but must be cut gradually to avoid glutting the market.

The logical disposal of privately-owned cutover lands in this region is to merge them with government lands. Large areas of cutover land or uncut land subject to timber rights have already been acquired by the Forest Service. How far and how fast this procedure is going to continue, what the prospects are that any given tract will be acquired, and to what extent the owner will be compensated for stumpage and young growth are questions which can not be answered in this paper. There is every reason to believe, however, that large additional acreages of cutover land will be acquired sooner or later, and that in such acquisition preference will be given to lands which have substantial forest values.

Granting that the private owner in the Southwest is not in a position to practice the kind of forestry that is required to produce full timber crops, let us consider how far he might go, without financial loss to himself, toward leaving his lands in reasonably productive condition. If the land is stripped of timber and devoted entirely to grazing, it may under conservative use bring a yearly rental of 3 or 4 cents an acre. Whether the owner can realize more by running his own stock depends on many circumstances. It is well known, however, that land ownership has not been conducive to prosperity among live-stock men in the Southwest. Experience has shown, also, that attempts to utilize the last spear of grass and to increase the forage by burning young tree growth results in quick decline of range values. The federal government is now spending millions in an attempt to reclaim overgrazed

lands—many times what they will ever be worth for forage production—in order to protect other property from the menace of flood and silt originating on overgrazed lands. After his holdings have been clear cut, the private owner will have to depend for current revenue primarily upon grazing receipts, which will seldom be enough to cover interest on an investment of $1 per acre. But if not more than a thousand board feet per acre of timber is left, the land will for many years produce almost as much forage as if all merchantable timber were removed. In other words, by leaving a fair growing stock of young trees the owner can realize nearly full grazing returns and at the same time be growing a crop of timber. Even if this timber can not be cut within the owner's lifetime, it will add greatly to the value of the land for both commercial and public purposes. A volume as low as 500 board feet per acre in the form of thrifty small trees will in 20 years increase to a thousand board feet, and if there are considerable numbers of poles below merchantable size at the time of cutting they will make a substantial additional contribution.

In saw-timber operations, a growing stock made up of small trees represents a lower investment than their volume would indicate. Investigations in the Northwest[3] have shown that trees below 16 inches d.b.h. are usually handled at a loss to the operator. Although the limit may be lower in this region, it is probably well above 12 inches. At any rate, it is safe to say that stems below 16 inches d.b.h. have a lower stumpage value for lumber than do those of larger diameter. This is a subject which deserves investigation in the interest of the lumberman as well as the public. When there is a market for ties, stulls, and props, smaller sizes can be handled at a profit; but the same principle applies here as in saw-timber operations. Trees which are just below the line of economic utilization today will grow into profitable size in 10 to 20 years. For this reason tie, stull, and prop material should be cut with a view to removing trees of poor form and opening up over-dense stands to promote rapid growth of the remaining trees. On lands which are accessible to markets for small material, improvement cuttings and thinnings may be made at short intervals with benefit to the remaining stand.

Seed trees are needed in all types of cutting in order to stock vacant spots. Relatively large trees are desirable for this purpose. In the national forests, it is the practice to select specimens of good form because, besides being superior for reproductive purposes, they put on a high quality of increment. If this class of seed trees can not be spared, a good deal may still be accomplished by leaving large low grade trees at little or no cost to the land owner or operator.

I have dwelt mainly upon tangible assets to the owner and the present day society in which he lives, because this is the problem of most immediate concern. There is another thought, new in this country but as old as forestry itself—that natural resources are the heritage of posterity, and not for the individual to do with as he sees fit. In European countries, such as Germany, France, Sweden, and Switzerland, timbered estates have been handed down from generation to generation. They are a source of revenue to the present owner and his descendants; but they are more than that. They are part of th national wealth; they furnish timber, fuel, water, recreation, and other things that are in-

[3]Gibbons, W. H., Johnson, H. M., and Spelman, H. R. The effect of tree sizes on western yellow pine lumber values and production costs. The Timberman, V. 30, No. 12, V. 31, Nos. 1 to 5. 1929-1930.

dispensable to a nation. The land owner may harvest the products of his forest in an orderly manner, but he may not impair its productivity; on the contrary, he is expected to hand it down to his descendants in an improved condition, if possible.

A transition from the individualistic to the socialistic order can not be accomplished overnight, nor by legislation which does not recognize personal rights and financial obligations. The greatest obstacles to private forestry in this country are the high capitalization of the timber industry and the low market price of forest products. Perhaps, as Wilson Compton suggests in the January issue of the JOURNAL, a further reduction of available timber supplies must precede the economic adjustment necessary to make private forestry self-sustaining. Granting that this idea has merit, it does not justify (as Compton also recognizes) a practice which destroys the timber producing capacity and the recreational and other indirect values of forest land. The private owner may have a heavy investment in stumpage, but his investment in the land itself is usually low. It is measured not by what the owner has paid for it, nor by its earning power, but by what he hopes to realize if he can sell it.

But the time has come when large purchases of cutover lands in the Southwest, and probably in other regions, will be confined largely to public agencies. The price paid for such land by the government, states, or municipalities is going to be determined solely by the public values vested in it. Except in rare instances, forest denudation can only serve to depreciate the prospective sale value. The old argument that destructive logging methods lower the cost of operation is finding less and less support. Cutting to a minimum usable diameter lowers the net profit; at best it merely increases the immediate gross returns at the expense of future income. Since destructive exploitation is of doubtful benefit to the owner and is in every way detrimental to public interest, the public is warranted in demanding that the practice be stopped. Opinions may differ as to how far the private owner shall be required to go, unaided, toward practicing forest management; but enlightened public opinion will agree that, when a forest is logged, it is the owner's responsibility to leave the land in such condition that it can respond to the natural processes of regrowth.

FOREST FIRE DAMAGE STUDIES IN THE NORTHEAST

II. First-Year Mortality in Burned-Over Oak Stands

By PAUL W. STICKEL

Northeastern Forest Experiment Station, U. S. Forest Service

Where outright destruction does not occur, estimates of damage done to standing timber by fire are usually inaccurate. One of the principal reasons for this inaccuracy is that no account is taken of the subsequent mortality among the fire-injured trees. The data herewith presented show that in two northern oak stands the mortality the first year after burning amounted to 27 and 47 per cent of the number of trees, with smaller trees suffering relatively more severely than the larger ones. Furthermore, the data indicate that at least one growing season must elapse before mortality of injured trees can be ascertained.

THE estimating of damage done to standing timber by forest fires is a difficult task in any forest region. In the Northeast this problem is further complicated by the fact that generally the forest fires are of such a character as to cause varying degrees of injury rather than outright killing. This is particularly true in the case of the northeastern deciduous forests, where surface fires are the general rule and damage is largely confined to the butt sections of the trees.

In obtaining damage data on burned-over forest lands in the Northeast, the usual practice is for the local forest officer to examine the area directly after the fire has been extinguished. Unless extensive killing has occurred on the area, the forest officer very frequently states that no damage has been done except that some of the trees have been scorched at the base. It is only in exceptional cases, as for example in all large fires in Connecticut, that the original fire appraisal is checked by a reexamination of the burned-over area the same season the fire occurred; it is even rarer to find that the burn has been inspected the year following the fire in order to revise the original damage figures.

Several investigators (1, 2, 3, 4, 5) in other forest regions have called attention to the fact that time must elapse after burning before data can be obtained that will be representative of the true extent of the damage. This need for permitting the burn to "season" before attempting to make damage appraisals is particularly significant when dealing with trees larger than saplings.

Field Data

In connection with a study of the basal wounding of standing timber by fire, data were obtained which illustrate the degree of mortality which occurs the first year after fire in the scarlet oak-black oak (*Quercus coccinea* Muenchhausen-*Q. velutina* La Marck) and chestnut oak (*Quercus montana* Willdenow) cover types in southern New York. For one of the areas, the Ramapo fire, an account has been presented of the association between fire-damaged hardwoods and bark-beetle attack (6).

At Ramapo, Rockland County, and Lackawack, Ulster County, New York, forest fires occurred on April 24 and April 29, 1933, respectively. The former burned over 150 acres and the latter 640 acres. Both fires were of the surface type. The Lackawack fire was the hotter of the two. One factor which undoubtedly contributed to making this fire more intense was the presence of mountain laurel (*Kalmia latifolia* Linnaeus) which formed a uniform two-foot high understory beneath

the trees. The fact that all the laurel was dead, with the branches and twigs badly charred, indicated that the fire was largely carried forward by the highly inflammable laurel leaves. This resulted in much higher butt-scorching at Lackawack than at Ramapo.

At both places various species of oak dominate the stand; red and white oaks (*Quercus borealis* Michaux f. and *Q. alba* Linnaeus) occur in addition to the cover-type species mentioned above. The less frequent associated tree species are gray birch (*Betula populifolia* Marsh), pignut hickory [*Hicoria glabra* (Miller) Sweet], sassafras [*Sassafras variifolium* (Salisbury) Kuntze], flowering dogwood (*Cornus florida* Linnaeus), northern white and pitch pines (*Pinus strobus* Linnaeus and *P. rigida* Miller). At Ramapo, ground vegetation, with the exception of a few scattered clumps of mountain laurel, appeared to be largely lacking at the time of the fire.

For the purpose of investigating initial injury and subsequent mortality and deterioration of trees over one inch d.b.h., permanent plots slightly larger than one-half acre were established on each burn. Since the study is as much concerned with determining the relation of initial degree of fire injury to subsequent reduction in wood quality through burning and fungal and insect attack as it is with mortality, care was taken to locate the plots where outright destruction was at a minimum. Only live butt-scorched trees were tagged. At Lackawack the plot was established during August, 1933, about five months after the fire, while at Ramapo the work was done during September, 1933, or approximately six months after burning. The plots at both areas were reexamined during June, 1934.

The 1934 examination disclosed that a surprisingly large number of trees had died since the plots were established. The accompanying Tables 1 and 2 show the losses in number of trees and basal area, and the distribution of losses by species and diameter classes. The greater mortality took place on the Lackawack area, where 361 trees per acre, or 47 per cent, were dead, with a consequent reduction in basal area of 44.4 square feet per acre, or 37 per cent. As is to be expected, at both places the heaviest mortality occurred among the smaller sized trees, particularly those 5 inches or less in diameter. A removal of the discolored bark from the dead trees showed in many cases that even scorching with no actual burning of the bark was sufficient to cause a complete girdling of the tree, due to the killing of the cambium around the entire circumference.

All of the mortality reported above must be ascribed to fire injury, because no primary insect or fungi attacks were recorded. Secondary ambrosia and bark-beetles were already attacking many of the

TABLE 1

LOSSES IN NUMBER OF TREES AND BASAL AREA PER ACRE THE FIRST YEAR AFTER BURNING

	Rampo fire		Lackawack fire	
	Number	Per cent	Number	Per cent
A. By number of trees:				
Alive	439	73	413	53
Dead	160	27	361	47
Total	599	100	774	100
B. By basal area:	Square feet	Per cent	Square feet	Per cent
Alive	85.8	82	76.8	63
Dead	18.7	18	44.4	37
Total	104.5	100	121.2	100

injured conifers and hardwoods, but with the exception of the fungus (*Ceratostomella* sp.) causing blue stain in northern white pine, no fungus was found. One interesting association between insect attack and fire injury was noted in connection with the occurrence of the two-lined chestnut borer (*Agrilus bilineatus* Web.). This insect was invariably found working on the injured hardwood trees, in a narrow zone of living wood and bark immediately adjacent to fire-killed bark and wood. The engravings of this insect were so common that they were the only means of determining the extent of original cambium killing when trees had died before starting any callus growth along the edges of the dead cambial area, or where the surface of the wood around the circumference of the bole had assumed a uniform color.

Aside from indicating the very appreciable mortality which occurs on burned land, these data confirm the statement made by McCarthy (4) that at least one growing season must elapse before fire damage can be accurately determined. Since all the trees were alive five to six months after the fire occurred, an appraisal made at that time would have failed to show the true extent of killing. It is, therefore, evident that the four-months "seasoning period" after fire, set up by another investigator (1), cannot be applied to burns in northern oak stands.

TABLE 2

DISTRIBUTION OF LOSSES BY SPECIES AND DIAMETER CLASSES PER ACRE THE FIRST YEAR AFTER BURNING

	Rampo fire			Lackawack fire		
	Total	Dead		Total	Dead	
		No.	Per cent		No.	Per cent
A. By species:						
Scarlet oak	368	83	23	40	40	100
Chestnut oak	139	31	22	396	161	41
Red oak	25	10	40	23	---	---
White oak	26	5	19	246	126	51
Gray birch	36	31	86	—	---	---
Pignut hickory	5	---	—	---	---	---
Flowering dogwood	—	---	—	17	17	100
Northern white pine	—	---	---	46	17	37
Pitch pine	---	---	---	6	---	---
All species	599	160	27	774	361	47
B. By diameter classes:						
D.b.h.—Inches						
2	25	10	40	17	11	65
3	83	42	51	109	80	73
4	119	42	35	294	156	53
5	142	36	25	155	57	37
6	108	15	14	80	17	21
7	46	5	11	23	6	26
8	36	10	28	28	17	61
9	10	—	—	28	11	39
10	10	—	—	23	6	26
11	15	—	---	11	—	---
12	5	---	—	6	---	---
All diameters	599	160	27	774	361	47

References

1. Anonymous. 1933. How soon after a fire can damage be determined? Lake States For. Exp. Sta. Tech. Note 57, mimeo. 1 p.

2. Lachmund, H. C. 1921. Some phases in the formation of fire scars. Jour. For. 19 (6): 638-640.

3. ———. 1923. Bole injury in forest fires. Jour. For. 21 (7): 723-731.

4. McCarthy, E. F. 1928. Analysis of fire damage in southern Appalachian forests. Jour. For. 26 (1): 57-68, illus.

5. Mitchell, J. A. 1914. Fire damage in mature timber. Pro. Soc. Amer. For. 9 (2): 239-244.

6. Stickel, Paul W. 1934. Forest fire damage studies in the Northeast: I. Bark beetles and fire damaged hardwoods. Jour. For. 32 (7): 701-703.

EVERY one knows the Chile pine, for its horizontal branches bearing long cylindrical, horizontal or pendant branchlets covered by thick, leathery, spine-tipped, spirally-arranged leaves, separate it from all other hardy trees. It is often called Monkey Puzzle, a name that is said to have originated in a Cornish garden. The owner of an early introduced tree was exhibiting it to his friends, when one exclaimed "It would puzzle a monkey to climb that tree." "Good idea," said the host, "we might call it monkey puzzle," and the name remains.—*Quarterly Journal of Forestry* (English).

PHOTOPERIODISM IN FORESTRY

By S. R. GEVORKIANTZ and E. I. ROE

Lake States Forest Experiment Station, U. S. Forest Service

THE study of light in relation to plant growth has long been a subject of vital interest to plant physiologists, ecologists, and foresters. In the past, attention has been concentrated entirely on the quality and intensity of light. More recently, the discoveries of Garner and Allard (2, 3, 4) have shown that the duration of the daily periods of light have a profound effect upon the life functions of plants. This response to the length of continuous daylight periods is called *photoperiodism.*

This new concept already has changed the views and opinions of many plant physiologists. Although the principles have been verified by many investigators, the field is such a new one that as yet no general conclusions can be made. There is little doubt, however, but that applied plant sciences such as agronomy, genetics, ecology, and very likely forestry, will benefit a great deal once the length of day becomes well recognized as an environmental factor.

The length of day affects not only the amount of food produced by the plant but also the manner in which it is used. This is manifested by changes in total stem length, leaf surface area, root development, branching habit, bud activity, and leaf fall. It also influences the hydrogen-ion concentration of the cell sap and the carbohydrate content of the plant.

Garner and Allard found that by shortening the length of day, it is possible either to hasten or to retard flowering, and sometimes to prevent it altogether. Considering the equatorial length of daylight of 12 hours as standard and the length of day for different latitudes and different times of the year as varying from 0 to 24 hours, they divided plants into three categories:

1. Short-day plants — those able to bloom only if the daylight period is less than 12 hours.
2. Long-day plants—those requiring more than 12 hours for this purpose.
3. Everblooming plants—those indifferent to these limits.

Photoperiodism in Forest Tree Species

Although some little work has been done with agricultural plants, very little information is as yet available as to the effect of length of day on forest trees. The scientific control of light duration experiments with large trees is very difficult, but young seedlings lend themselves to such investigations equally as well as field crops. Although Garner and Allard used box elder, tulip poplar, and sumac, their main interest was in agricultural plants.

The recent investigations by Moshkov (5) and Bogdanov (1) in Russia show interesting results concerning the reaction of seedling trees to varying lengths of day. Both workers conducted their experiments in the vicinity of Leningrad, where the length of day reaches 20 hours on the 21st of June. Light-proof boxes were used for the experiments. Besides the control beds exposed to normal day length, Moshkov used 10-, 12-, and 14-hour light periods; Bogdanov, 9- and 13-hour periods. Precipitation obstructed by the boxes was supplied artificially, all other conditions remaining uniform. One- and 2-year-old seedlings of several species of the following genera were used: Acer, Aesculus, Ailanthus, Alnus, Cara-

gana, Corylus, Fraxinus, Juglans, Larix, Phellodendron, Pinus, Prunus, Pyrus, Rhus, Robina, Salix, and Ulmus.

Growing season.—According to Bogdanov, all species studied had their vegetative period shortened by decreasing the length of day. The short day caused premature cessation of height growth, more rapid hardening of young shoots, and earlier leaf fall. As a result, the seedlings matured earlier and became more frost resistant and winter hardy than those grown under the 20-hour period. For example, Robinia pseudoacacia under the normal Leningrad day (20 hours) does not finish its growth and is frequently damaged by fall frosts, but when 14- and 10-hour periods of light are used, the vegetative period lasts only eighty-three and thirty days respectively.

The maturation of shoots and leaf fall show the same general trends, most species completing their growth only under the 10-hour day. Shortening of the light periods when delayed until mid-summer produced the same effect as when the plants were subjected to it throughout the growing season.

Yearly growth.—The combined length of all shoots does not necessarily decrease in all species with the decrease in the length of day. Larix sibirica, Robinia pseudoacacia, Salix bicolor, and others showed the best growth of shoots under the Leningrad conditions, while Salix babylonica and Pyrus ussuriensis showed the greatest growth under the 14-hour period. This clearly indicates that different plants must have different photoperiods for optimum development.

It was also found that in some species an exposure to short light periods tended to exert its influence even after the plants had been previously exposed to long periods of light. For example, Moshkov found that when plants of Phellodendron amurense, grown under long-light periods for one year, were shifted the second year to short-light periods, they responded in the same manner as those subjected to short-light periods during both years. When, however, short-day plants were exposed to long-day conditions the following year, they showed a decrease in growth compared to that made by plants grown under the long-light periods for both years. This leads him to the conclusion that the shortening of the light periods, if necessary, could be started one year or more after seeding.

Development of secondary shoots.—The length of day was found to influence the development of secondary shoots, or the new growth developing from buds of the same year. Thus many pine seedlings from southern Russia grew two shoots a year under the Leningrad day, but only one when short-light periods were used. Under the latter periods buds opened up from five to ten days earlier in the spring than under the long-day conditions.

Morphological changes — Interesting morphological changes were caused by shortening the daylight periods. These included such things as branching habit, color and structure of leaves, appearance of thorns, size of cells, thickness of cell walls, root development, and starch accumulation. These effects were so marked that cuttings of the same parentage when grown under identical conditions, save the length of light periods, could be mistaken for different forms or varieties of the same species.

Salix babylonica plants, grown under 20-hour conditions, produce 74 secondary branches, while under 14-, 12-, and 10-hour periods only 57, 47, and 16 per cent of this number. The 20-hour plants had narrow-lanceolate, light yellowish-green, thin leaves; the 10-hour plants had broad-lanceolate, dark green, leathery leaves; the other plants developed leaves intermediate between these extremes. Black locust showed not only marked differences in branching habit and the color,

shape, and texture of its leaves, but also in the shape of the transverse section of shoots, size of thorns, shape of roots, and their starch content.

Frost resistance.—The Russian investigators also found that subjecting plants to short-day periods increased their frost resistance. This is a very practical feature, for it implies that the use of certain species in northern latitudes is limited, as under the longer daylight periods he plants will not mature before the fall frosts. Black locust from Caucasia had only four per cent survival under the 20-hour day, but complete survival under he 12- and 10-hour periods. Apricots from southern Caucasia were completely killed by frost under the normal Leningrad day, but under 10-hour conditions only the upper parts of shoots were frozen. In general, the more northern he origin of the plant, the less shortening of day it required to become frost resistant. In the introduction of exotic plants, therefore, one must consider, in addition to climatic factors, the normal photoperiodic requirements of the species n question.

According to Moshkov, the northern pecies such as Salix bicolor and Larix ibirica are frost resistant under Leningrad conditions. He believes that they hould be cultivated in the north and not n the south, where the days are short. He does not subscribe to the common belief that when these species are brought nto the south they will grow faster than n their native habitats.

Species such as Salix babylonica and yrus ussuriensis are not frost hardy in he vicinity of Leningrad and should be rown in the south, since it is not feable to shorten the days in a northern titude. When subjected to the northern imate and its attendant long days, these pecies do not complete their hardening nd are injured by frosts.

Practical considerations.—From these experiments it is evident that the duration of daily light periods is an environmental factor of considerable importance, a factor that must be taken into account by foresters as well as agronomists. The practical significance of this relationship cannot be fully recognized or appreciated until more research has been done. However, many grave mistakes can be avoided by a knowledge of photoperiodism, and some of the more puzzling problems can be cleared up once its principles become thoroughly understood.

The length of daylight periods may possibly have some bearing on drought resistance of plants, but as yet nothing definite is known about this important characteristic. Similarly, tolerance of forest trees to shade may possibly be connected with the length of day.

Additional studies of photoperiodism in forest tree species should be made. While waiting for the results of these studies it would be highly advisable to use great caution in shifting plants out of their native habitats, especially where any great difference in latitude is involved.

References

1. Bogdanov, P. L. 1931. O Fotoperiodizme u drevesnykh porod. (Photoperiodism in forest trees) Trudy i Issledovania po Lesnomu Khoziyastvu i Lesnoi Promishlennosti (Works and investigations in forestry and forest industry) 10: 21-55, illus. With German summary.

2. Garner W. W. and Allard, H. A. 1920. Effect of the relative length of day and night and other factors of the environment on growth and reproduction in plants. Jour. Agr. Research. 18: 553-606.

3. ———— and ————. 1923. Further studies in photoperiodism, the response of the plant to relative lengths of day and night. Jour. of Agr. Research 23: 871-920.

4. ————, Bacon, C. W. and Allard, H. A. 1924. Photoperiodism in relation to hydrogen-ion concentration of the cell sap and the carbohydrate content of the plant. Jour. Agr. Research 27: 119-156.

5. Moshkov, B. S. 1932. Fotoperiodizm drevesnykh porod i ego prakticheskoe znachenie (Photoperiodism in trees and its practical importance.) Trudy Prikl. Bot. Gen. i Selek. Ser. A., Sotsial. Rast. (Bull. Appl. Bot. Gen. and Plant Breed. Ser. A, Social Plant Ind.) 2: 108-123, illus.

ONE of the most remarkable trees in Scotland, and one which has carried the name of its estate to all ends of the earth where ornamental trees are encouraged, is the fastigiate beech at Dawyck, near Peebles (Mr. F. R. S. Balfour). This tree, known in the arboricultural world as "The Dawyck Beech," is the parent of all the fastigiate beeches now in commerce. It was found some years ago in a hedgerow at Dawyck, and removed to the garden—*Quarterly Journal of Forestry* (English).

SOME AGENCIES ATTACKING BLISTER RUST ON WHITE PINE

By ERNEST E. HUBERT

School of Forestry, University of Idaho

Large sums of money are being spent in the United States in the control of white pine blister rust. The author describes various biological agencies which attack the blister rust organism. How important these are or may be in the control of the disease has not yet been determined.

THERE are several examples on record of the successful or attempted application of biological ontrol to a number of serious and damging plant pests. In most of these ases an insect is used, which habitually ttacks the insect causing the crop damge, as for example, the ladybug and the phid. The object of such methods is to ring about a sufficient reduction of the rop-eating insect to constitute an effective ontrol measure. There are many examles in nature of the reduction of funus or other plant pests by means of ungi or insects; and some of these come nto the realm of forestry. A good examle is the destruction in local areas and uring favorable seasons of an entire eed crop of one of our common dwarf nistletoes, *Razoumofskya campylopoda,* y a parasitic fungus, *Wallrothiella areuthobii.* Another example may be found n the group of fungi which attacks cerain agarics or mushrooms common in ur forests, destroying the fruiting body, ncluding the spore-bearing layer. We ave also many cases in which especially dapted insects feed upon and destroy ne sporophores of a number of woodestroying fungi before they are capable f producing spores.

In Europe, considerable attention has een given this method of using biological agencies in an effort to control orest tree diseases; and with some neasure of success, according to pubshed reports. These attempts were main- aimed at the control of the white pine lister rust on European forest lands, and some of these efforts were reported to have greatly reduced, and in some cases inhibited, the production of the rust spores.

The fungus used in these European experiments is known as the purple mold, *Tuberculina maxima* Rostr., a purple colored organism which has been recognized as a parasite of the white pine blister rust for many years. Tubeuf (6, 7, 8, 9, 10) has been the principal champion in Germany of the use of *T. maxima* as an agency in the control of the white pine blister rust. Observations and experiments were continued by him until his recent paper (10) appeared, reporting the successful use of the parasite in greatly reducing or entirely inhibiting the production of æciospores of the rust in certain regions of Germany.

Lechmere (2) in 1914 gave additional details regarding the life history of the purple mold, and concluded that it restricted its attack to the pycnial and æcial structures entirely and did not penetrate the pine host tissues, nor did it attack or destroy the rust mycelium. Spaulding (5) in 1929 and Rohmeder (4) in 1931 report a marked reduction in æciospore production in several regions, including England, Denmark, Belgium, and Germany. Rohmeder's reports cover several areas in the Swabian forest regions.

In this country the first note of the occurrence of *T. maxima* was made by Weir and Hubert (11) in 1917, recording the presence of this parasite on the native pine rusts in Montana. Since that time the purple mold has been more com-

monly observed on native rusts throughout the western United States and Canada and on white pine blister rust in Canada. Mielke (3) and others have collected it in fairly large quantities on the white pine blister rust in British Columbia and in the northwestern United States.

Facts concerning the life history of the purple mold are meager, and but one spore stage is known. The fungus is supposed to attack the spores of the rust, but not the mycelium, and is not known to attack the bark or wood tissues of the white pines. Field observation of this mold on native rusts in Idaho and Montana and on the blister rust in Idaho indicate that it develops readily upon the pycnial stage of the rust and under favorable weather conditions attacks the æcial stage. The purple layer which appears on blister rust cankers is a mass of large purple-colored spores. These are carried by winds and insects to other cankers, where new infections are started. Whenever this purple layer is present on the blisters of the canker the rust spores are no longer produced (Fig. 1). Detailed studies of the effect of the purple mold on the blister rust fungus have not been made, but preliminary examinations of the rust-bearing tissues of the pine show the purple mold penetrating some distance below the spore masses in the fruiting structures of the rust.

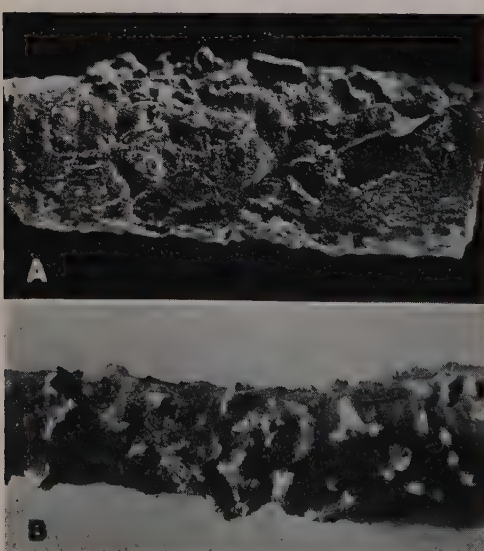

Fig. 1.—*A*. Aecial scars of white pine blister rust, *Cronartium ribicola*, on *Pinus monticola*, overgrown by the rust parasite, *Tuberculina maxima*. Note the moldy appearance and absence of peridia or blisters. Slightly enlarged. *B*. Uninfected aecial blisters of *C. ribicola* on *P. monticola*, showing clear cut outlines and the absence of moldy growth. Normal condition of rust canker.

Attempts were made in 1931 and 1932 (1) to inoculate blister rust cankers in several regions of Idaho with the spores of the purple mold obtained in Germany from Dr. Tubeuf and in the United States and Canada from native infections. The results showed that only a small percentage of the inoculations were successful. One infection at Newman Lake, Wash., has remained active since 1932 and has spread slightly to nearby cankers each year. Attempts have also been made to grow the fungus on artificial media in the laboratory, with the object of rapidly producing large quantities of the spores for distribution in blister rust infected areas. These experiments had to be discontinued, and no further progress has been made.

Granting that the purple mold inhibits and in some cases destroys rust spore production on infected pines, we have insufficient knowledge of its rate of spread and effectiveness in this country to gauge its usefulness as a means of biological control. Under optimum conditions it might be possible to enlist the purple mold as an aid in the control of the blister rust fungus, but it could never take the place of the mechanical, chemical, and other control methods already tested and now in use over vast areas of white pine timber.

Other Agencies

There are a number of other organ

sms which attack the white pine blister ust. Many of these are known as secndary fungi, and they are found devel-ping upon the dead rust or upon the ead, dying, or infected canker tissue. uch fungi hasten the death of the canker issue, prevent a further development of he rust in these tissues, but are not apable of attacking the living rust or-anism of the living healthy tissues of he host. This class of fungi usually astens the girdling action begun by the lister rust.

Another group of agencies comprise the nsects, a number of which attack the iving or dead rust fungus, the older ankered tissue, or the newly infected ine tissues. There are a number of in-ects which feed upon the fruiting por-ions of the different stages of the rust. 'hese are for the most part small coleop-erous larvæ of an orange color, which at the spores and a certain amount of ecial or uredinial mycelium. In this lass may also be placed a large variety f insects, such as flies, wasps, hornets, nts, and others, which feed upon the ycnial juice and incidentally upon the ycniospores. The insects which attack he canker or the infected tissues are not s numerous, and have, therefore, received ess attention. Larvæ of bark-inhabiting eetles are occasionally noted, and on ertain caulicolous rusts native to the Vest there is often found a characteristic mall brown beetle (*Epurea orata* Rand), he larvae of which destroy the entire ruiting layer so that the gall or canker s left bare of bark or rust pustules.

Rodents, as agencies destroying blister ust infections on pines, have received onsiderable more attention than the other gencies, since their work is more evident nd attracts the eye. Squirrels, field nice, and other rodents quite frequently eed upon the spongy infected bark tissues f the young cankers or the younger ortions of old cankers. These animals occasionally strip off most of the infected tissue on all the lesions and cankers within a given area. This is noted on young infections in regions where pine squirrels run out of their regular food supply and turn to the blister rust cankers for emergency rations. An occasional rabbit will nibble cankered areas on lower branches or trunks which are in reach during winters when the snow is deep. Porcupines habitually feed upon coniferous bark and occasionally strip off the infected bark on the main stems or larger branches. Field mice and wood mice are less commonly found attacking the rust infected tissues of pine, and when they do it is usually on very young reproduction which bear either stem or branch infections near the ground.

While all of these natural agencies destroy a certain amount of blister rust infection and in limited local areas greatly reduce the total infection, yet the sum total is small and we can not look forward to the use of these agencies, as they now operate, for any considerable amount of control. The natural agencies are slow and erratic in their attack upon the rust, and with the present rapid spread of the rust in the western United States control methods, if they are to be effective, must give immediate results and must be applied over the entire host area as rapidly as possible. A study of the numerous agencies attacking the blister rust should, however, be conducted so that the value of each agency and of the agencies combined may be determined.

References

1. Hubert, E. E. 1935. Observations on Tuberculina maxima Rost. A parasite of Cronartium ribiocola Fischer. Phytopath. 25: ——

2. Lechmere, E. 1914. Tuberculina maxima Rost. ein Parasit auf den Blasenrost der Weymouthskiefer.

Naturw. Ztschr. Forst u. Landw. 12: 491-498, illus.
3. Mielke, J. L. 1933. Tuberculina maxima in western North America. Phytopath. 23:299-305.
4. Rohmeder, E. 1931. Anbaufläche und Gefährdungen der Strobe im bayerischen Staatswald. Forstw. Cenralblatt 53:325-339.
5. Spaulding, P. 1929. White pine blister rust: a comparison of European with North American conditions. U. S. Dept. Agr. Tech. Bull. 87:39.
6. Tubeuf, C. von. 1902. Ueber Tuberculina maxima, einen Parasiten des Weymouthskiefern - Blasenrostes. Arb. aus d. Biol. Abt. f. Land u. Forstw. am Kaiserl. 2:169-173.
7. ————. 1914. Biologische Bekampfung von Pilzkrankheiten der Pflanzen Naturw. Ztschr. Forst. u. Landw. 12:11-19; 484-491.
8. ————. 1917. Ueber das Verhältnis der Kiefern-Peridermium zu Cronartium. Naturw. Ztschr. f. Forst. u. Landw. 15:302-304.
9. ————. 1926. Blasenrost der Weymouthskiefer. Ztschr. f. Pflanzenkr. 36:143-146.
10. ————. 1930. Biologischen Bekämpfung des Blasenrostes der Weymouthskiefer. Ztschr. f. Pflanzenkr. u. Pflanzenschutz. 11:177-181.
11. Weir, J. R. and Hubert, E. E. 1917. Pycnial stages of important forest tree rusts. Phytopath. 7:135-139.

EFFECT OF WEATHERING UPON DRY MATTER AND COMPOSITION OF HARDWOOD LEAVES

By HERBERT A. LUNT

Connecticut Agricultural Experiment Station

IN A previous article[1] the writer presented data showing some of the changes in composition of hardwood leaves during the first 7 or 8 weeks following leaf fall. The species investigated—hickory, white oak, beech, and maple (sugar and red maple mixed)—showed relatively little change in calcium content, but there was a distinct loss in potassium and phosphorus. However, no measurements were made on the loss in dry matter, and because of that fact the total loss of constituents could not be determined.

Since that time the experiment has been repeated on a somewhat larger scale, with cognizance taken of the dry matter loss. The procedure followed in collecting the leaf samples was identical to that used previously. However, in the case of the samples left out for weathering, instead of spreading the leaves out on the ground under a square of poultry wire, definite weighed amounts of leaves—75 to 200 g.—were placed in flats, such as are used in greenhouse work, measuring 11 x 18.5 x 3 inches inside, and constructed of wooden sides and ends, and a ⅛-inch mesh hardware cloth bottom. The flat was covered with ¼-inch hardware cloth to prevent the leaves from blowing away. These were placed on the ground under the tree from which the leaves were taken and were allowed to remain there seven weeks. Similar samples of the freshly collected leaves were taken to the laboratory, dried at 32 to 33°C., and weighed. At the end of the period the exposed samples were brought in, dried at 32-33°C., and weighed, and then all samples were analyzed.

The locations and tree species selected for this study were as follows: *A*. Mount Carmel, on the property of E. Minor. A stand of unevenaged mixed hardwoods on Holyoke fine sandy loam soil. Species: beech (*Fagus grandifolia*), dogwood (*Cornus florida*), sugar and red maple (*Acer saccharum* and *A. rubrum*).

B. Experiment station grounds, New Haven. Shade trees surrounded by lawn, on Wethersfield fine sandy loam soil. Species: sugar maple, shagbark hickory (*Carya ovata*), and white oak (*Quercus alba*).

The results of the analysis, on a percentage basis, are given in Table 1. The potassium and phosphorus losses are considerably smaller than they were in the 1932 experiments, a variation readily accountable for by the difference in rainfall in the two years. During the several periods of exposure in 1932 the approximate precipitation was as follows: during the exposure of the hickory, 11.2 inches; of the white oak, 9.1 inches; of the beech, 8.2 inches; of the maple, 8.7 inches. In contrast, the precipitation in 1933 was only 2.5 inches during the seven-week period.

In both experiments losses of K and P were highest in the beech, and losses of P were lowest in the hickory leaves. Changes in both calcium and nitrogen were relatively small.

In order to get at the true changes in composition following leaf fall,

[1]Lunt, Herbert A. 1933. Effect of weathering upon composition of hardwood leaves. Jour. For. 31:43-45.

the data were recalculated on the basis of the amount present in the unweathered leaves. In other words, out of 100 grams of original material, how many grams of each constituent were lost in the weathering process and what was the percentage loss? These data are given in Table 2.

The loss in dry matter was greatest in the red maple and the dogwood leaves, and least in the beech and oak. This dissimiliarity in dry matter loss is reflected in the percentage losses of the individual elements, changing their order relative to the amount of loss and in some cases converting an apparent loss into a gain, or vice versa. These results confirm those of the previous experiment, and in addition serve to show what may be expected in changes in dry matter of the several species during the period immediately subsequent to leaf fall.

TABLE 1

EFFECT OF WEATHERING UPON COMPOSITION OF FOREST LEAVES.[1] PERCENTAGE BASIS. 1933 RESULTS.

	Ash	Ca		K			P		N
	Per cent	Per cent	Per cent of ash	Per cent	Loss Per cent	Per cent of ash	Per cent	Loss Per cent	Per cent
Mt. Carmel samples									
Beech									
Fresh	6.65	0.596	8.96	1.255		18.87	0.306		0.662
Weathered	5.97	0.606	10.15	0.693	44.9	11.60	0.201	34.3	0.694
Dogwood									
Fresh	9.32	2.078	22.30	1.693		18.16	0.204		0.658
Weathered	8.59	2.226	25.91	0.979	42.2	11.40	0.173	15.2	0.745
Red Maple									
Fresh	5.310	0.948	17.85	0.745		14.03	0.183		0.530
Weathered	6.205	1.100	17.72	0.567	23.9	9.14	0.153	16.4	0.603
Sugar maple									
Fresh	8.100	1.627	20.09	0.875		10.80	0.214		0.740
Weathered	8.750	1.668	19.06	0.682	22.1	7.79	0.187	12.6	0.780
Experiment station samples									
Sugar maple									
Fresh	7.950	1.593	20.03	0.976		12.27	0.092		0.648
Weathered	8.750	1.818	20.77	0.682	30.1	7.79	0.080	13.0	0.605
Hickory									
Fresh	9.815	2.161	22.02	1.370		13.95	0.119		0.721
Weathered	9.820	2.358	24.01	0.866	36.8	8.81	0.123	+3.4	0.781
White oak									
Fresh	5.895	1.522	25.81	0.610		10.34	0.179		0.499
Weathered	5.890	1.568	26.62	0.433	29.0	7.35	0.154	14.0	0.680

[1]Approximate rainfall during the period of exposure, 2.5 inches.

TABLE 2

LOSSES OF THE SEVERAL CONSTITUENTS, BASED UPON THE AMOUNT ORIGINALLY PRESENT IN 100 GRAMS OF UNWEATHERED LEAVES. 1933 RESULTS.

	Dry matter		Total loss, in grams and percentage									
		Loss	Ash		Ca		K		P		N	
	g.	Per cent	g.	Per cent	g.	Per cent	g.	Per cent	g.	Per cent	g.	Per cent
Mt. Carmel samples												
Beech												
Fresh	100											
Weathered	97.3	2.74	.845	12.7	.007	1.17	.581	46.29	.110	35.9	+.013[1]	+1.96
Dogwood												
Fresh	100											
Weathered	88.4	12.29	1.727	18.53	.110	5.29	.828	48.85	.051	25.0	+.0005	+0.08
Red maple												
Fresh	100											
Weathered	87.6	12.44	+.125	+2.35	+.016	+1.69	.248	33.3	.049	26.8	.002	0.38
Sugar maple												
Fresh	100											
Weathered	93.0	7.03	+.037	+ .456	.076	4.67	.241	27.54	.040	18.7	.015	2.03
Experiment station samples												
Sugar maple												
Fresh	100											
Weathered	93.3	6.72	+.213	+2.68	+.103	+6.46	.340	34.83	.017	18.5	.084	12.96
Hickory												
Fresh	100											
Weathered	93.3	6.69	.653	6.65	+.039	+1.80	.562	41.00	.004	3.4	+.008	+1.11
White oak												
Fresh	100											
Weathered	97.4	2.59	.158	2.68	+.005	+ .33	.188	30.80	.029	16.2	+.163	+32.67

[1]Plus sign (+) indicates gain instead of loss.

Formulae: 1. $f-(wd)=g$

2. $\frac{g\times 100}{f}$

In which: f=Percentage of element in fresh leaves.
w=Percentage of element in weathered leaves.
d=grams of dry matter, weathered leaves.
g=Loss of the element, grams.
p=Loss of the element, per cent.

GROWTH IN A SELECTIVELY LOGGED STAND IN LOUISIANA BOTTOMLAND HARDWOODS

By V. B. DAVIS

Southern Forest Experiment Station

THE bottomland hardwood forests of the Mississippi River Delta region cover an area of approximately 15 million acres, mostly in Arkansas, Louisiana, and Mississippi, and a relatively small area in Missouri and Tennessee. It is estimated that 10 per cent of this area is occupied by virgin old-growth forests, and that an additional 30 per cent is occupied by second-growth stands and partly-cut old-growth stands having sufficient volume of sawtimber per acre for commercial cutting. The forests of this region supply at present 25 per cent or more of the hardwood lumber cut in the United States.

Selective logging as a means of perpetuating or prolonging the life of a sawmill operation is not as yet extensively practiced in these forests, and little definite information is available as to the rate of growth which may be expected. A few operators have in the last 5 or more years adopted a policy of partially cutting their hardwood timber stands with the purpose of leaving sufficient growing stock to provide for future cuttings of high-grade material. By a careful selection of trees to be cut in uneven-aged virgin forests, which are commonly found in this region, the loss through death and decay can be greatly reduced. By removing the slow-growing, old, decadent trees the rate of growth of the younger, thrifty trees is increased by freeing them from the shade and competition of these older associates.

This study represents the findings on but one selectively logged virgin stand of the red gum ridge-oak type in central Louisiana. Further studies in this and other types for both old-growth and second-growth bottomland hardwoods will be necessary before the full possibilities of selective logging in the Mississippi Delta region can be evaluated.

The stand-growth figures presented in this paper were obtained from a study made on a plot established in September, 1933, in St. Landry Parish, La. The plot was rectangular in shape, 8 chains by 15 chains on a side, with an area of 12 acres. It was in timber of the red gum ridge-oak type which, previous to the cutting made in the winter of 1925-26, was practically in virgin condition and contained many mature and overmature trees. An occasional old stump and released growth on some of the standing trees indicated that a few trees had been cut from the area about 1916. This stand may be taken as representative of areas of similar type and condition in the Delta.

The cutting made during the winter of 1925-26 actually consisted of two operations. The first was planned with the intention of removing only the obviously overmature and deteriorating trees. The second was necessitated by a storm immediately following the first cutting and was for the purpose of salvaging timber blown down or damaged. Not only the planned cutting but also the storm and subsequent salvage cutting contributed to the opening up of the stand and improved growing conditions for the trees which remained. Obviously, however, such a release was not as effective in promoting growth for the stand as a whole as a cutting carefully worked out for that purpose would have been.

It is not expected that the maximum volume-growth possibilities will be attained within 8 years after the first cut,

nor even within the first cutting cycle, in a stand originally stocked largely with mature and overmature trees. A certain amount of time is required to build up the growing stock to the desired condition.

It should be noted that the period of growth following cutting came soon after the drought of 1924, which resulted in considerable loss through mortality for several years following its occurrence. The net growth is therefore probably low compared to what might normally have been expected.

It follows, then, that the growth during the 8 years between the logging and the date of this study does not cover the full possibilities of a stand handled over a long period of time under a system of carefully planned selective cutting.

Data Secured

The following data were recorded for each tree over 9 inches in diameter on the plot: Species, diameter at breast height (4½ feet above ground), crown form, present merchantable length, estimated merchantable length at date of the cutting, and diameter growth at breast height for the 8 years following the cutting and for the 8 years preceding the cutting (obtained from increment borings). In addition, the present merchantable length of the tree was divided up into log lengths, and the length, grade, and estimated diameter at the small end recorded for each log. Note was made of any change in log grade which was believed to have occurred since the date of the cutting.

The number of trees removed in logging was determined from the stumps on the area, and their diameters and merchantable lengths were estimated from the size of the stump and from the position and size of the tops, which were usually to be found where they had fallen when the trees were cut. The volumes of felled trees were then computed from volume tables.

All dead trees which by their condition indicated that they had died since the date of logging were tallied by diameter and merchantable length and their volumes obtained from volume tables.

Volume Computations

The volume in each dead tree as figured above consists of its volume at the date of cutting plus whatever growth took place in the tree between this date and its death. The amount of the growth (estimated as 27 board feet per acre) was

Table 1

SUMMARY OF PLOT VOLUME[1] AND GROWTH DATA

Item	Board feet per acre				
	In log grade 1	In log grade 2	In log grade 3	In log grade 4	In all grades
Volume now (1933)	1,030	3,731	285	3,073	8,119
Volume at time of cutting, 1925-26 (in trees surviving until 1933)	826	2,915	296	2,258	6,295
Volume growth for 8-year period since time of cutting	204	816	11	815	1,824
Loss through mortality (volume in 1925 of trees which died during 8-year period)	——	——	——	——	424
Net gain in volume for 8-year period	------	------	------	------	1,400
Net gain in volume per year	——	——	——	——	175
Volume logged in 1925-26	——	——	——	——	5,777

[1]Volumes are by Scribner log scale.

deducted from the volume of each dead tree. Hence the figure used for volume of each tree which died represents its volume at the date of the cutting.

Volumes of trees standing when the plot was established (1933) were computed from the tally of logs in the standing trees and a log-scale table. The volume in these trees at date of cutting was computed by making a reduction in the present diameter of each log equal to 0.8 of the diametric growth of the tree since the cutting. This factor of 0.8 was used because the diameter inside bark at the top of the first log is approximately 0.8 of the diameter at breast height for trees of the species involved in this study.

Table 1 shows, on a per-acre basis, the stand volume in 1933, the volume at time of cutting in trees which lived through to 1933, gross volume growth for the 8-year period since cutting, the volume loss through mortality, the net volume increase for the 8-year period, and the net volume growth per year. Volume now and volume at release are given by log grades.

Log Grades

Logs falling in grades 1 and 2 are those of the quality which would ordinarily be taken in lumber-mill log purchases on the open market. Logs of grade 1 should cut 60 per cent or more of No. 1 common or better lumber. Logs of grade 2 should cut 35 per cent or more of No. 1 common or better lumber.

In general, the minimum log diameters for logs of grade 1 and 2 are 18 inches and 14 inches, respectively; however, exceptionally good logs not more than 2 inches below these limits are permitted in each grade. For ash, the minimum for grade 1 is 14 inches and for grade 2 is 12 inches.

Grade 3 includes logs of high quality

Table 2

AVERAGE PER ACRE BY LOG GRADES IN 1933

Item	Number of board feet				
	In log grade 1	In log grade 2	In log grade 3	In log grade 4	In all grades
Volume in trees 28 inches and over in diameter	902	2,018	—	1,047	3,967
Volume in trees under 28 inches in diameter	128	1,713	285	2,026	4,152
Total volume	1,030	3,731	285	3,073	8,119

Table 3

SHOWING NUMBER OF TREES BY DIAMETER CLASSES FOR THE 12 ACRES[1]

Diameter class—inches	Trees logged (1925-26)	Mortality (1926-33)	Trees having board-foot volume at date of measurement (1933)
12-15	----	2	62
16-19	--	2	52
20-23	1	5	55
24-27	2	3	38
28-31	7	1	32
32-35	17	1	14
36-39	11	--	4
40-43	4	-	1
44-47	8	-	1
48-51	1	--	–
Total	51	14	259
Average per acre	4.2	1.2	21.6

[1]Culls and trees too small to make sawlogs are not included.

but too small or having too much sweep to be classed as grade 2. Logs of this grade are particularly suitable for the production of staves and small dimension. The minimum diameter for this grade is 9 inches.

Grade 4 includes logs falling below the requirements of the previous grades but not less than 10 inches in diameter and suitable for the production of ties, rough structural material, and box and crate lumber.

Table 2 gives the average board-foot volume per acre by log grades in trees 28 inches and over in diameter and in trees under 28 inches in diameter. A comparison of the figures for the two groups shows that in trees 28 inches and over, 74 per cent of the volume is in log grades 1 and 2, while in trees under 28 inches in diameter only 44 per cent of the volume is in these two upper grades. This shows the advantage of confining the cut to the larger diameters and leaving the smaller trees to increase in quality and volume.

Table 3 presents a stand table of all trees on the plot which had a board-foot volume at time of measurement in 1933. This table also shows by diameter classes the number of trees logged and the number of trees which died between logging and the date of plot establishment.

Volume Growth

Table 1 shows that an average gross increase in volume of 1,824 board feet per acre took place in trees living through from the date of logging (1925-26) until the date of measurement, September, 1933. Of this, 1,598 board feet was the increase in volume of trees which were of sawlog size at the time of logging, and 226 board feet are accounted for by trees which grew into sawlog size during this 8-year period. An average loss of 424 board feet per acre occurred during this

Table 4

Eight-year volume growth (1926-1933) per tree, by species and diameter group[1]

Species	9 inches to 14 inches		15 inches to 20 inches		21 inches to 26 inches		27 inches to 32 inches		33 inches up	
	Number of trees	Average growth board feet per tree	Number of trees	Average growth board feet per tree	Number of trees	Average growth board feet per tree	Number of trees	Average growth board feet per tree	Number of trees	Average growth board feet per tree
Cow oak	33	25	17	48	31	86	25	91	5	125
Cherrybark oak	29	65	9	196	6	211	1	261	2	201
Water oak	30	50	27	116	12	163	3	194	-	-
Red gum	12	16	6	32	3	89	4	82	1	51
White elm	15	28	9	21	3	21	-	-	-	-
White ash	3	52	1	125	-	-	-	-	-	-
Green ash	5	6	1	32	-	-	-	-	-	-
Nuttall oak	2	32	1	92	-	-	-	-	-	-
Winged elm	3	20	-	-	-	-	-	-	-	-
Black gum	7	12	-	-	-	-	1	98	-	-
Red maple	3	28	-	-	-	-	-	-	-	-
Honey locust	5	19	-	-	-	-	-	-	-	-
Hackberry	1	13	-	-	-	-	-	-	-	-

[1]Grouping is by size at date of cutting, 1925-26.

8-year period in trees which died, making the net increase in volume 1,400 board feet per acre for the 8 years, or 175 board feet per acre per year.

The volumes assigned to standing trees in this study were intended to include all material which might conceivably be used for lumber, staves, ties, etc. It is recognized that few if any lumber mills at the present time would utilize for sawtimber the full volume shown for the plot. Under a system of selective logging where the cut is made entirely from trees of the larger diameters, it is only the utilization in such trees with which we need be concerned. Utilization varies considerably from one operation to another. It is estimated that 80 per cent or more of the volume in trees of the larger diameters will be used by the average lumber operator, while some will undoubtedly use practically the entire volume. For an operation where only 80 per cent of the volume is utilized, the available growth per year would be 140 board feet per acre.

Table 4 shows for each species the average board-foot volume growth per tree by diameter groups. The growth shown in the 9- to 14-inch class is comparatively low, due to the fact that many trees in this class did not reach the minimum size on which board-foot volume is figured.

Table 5, giving for each species the average diameter growth for the 8-year periods before and following cutting, shows how the various species responded to the opening up of the stand.

Summary

In 1933, growth was studied on an area of 12 acres in a bottomland hardwood stand selectively logged in the winter of 1925-26, which produced 5,777 board feet per acre. After the logging, a stand of 6,719 board feet per acre remained. Of this, 6,295 board feet were in trees which survived through to 1933, while 424 board feet were in trees which died between 1925 and 1933.

The trees which survived had a volume in 1933 of 8,119 board feet per acre; this represents a total growth of 1,824 board feet, or a net growth during the 8-year period (1926-1933) of 1,400 board

Table 5

SHOWING AVERAGE DIAMETER GROWTH BY SPECIES FOR 8-YEAR PERIOD BEFORE AND AFTER THE CUTTING

Species	Number of trees	8-year diameter growth since cutting (1926-1933) inches	8-year diameter growth before cutting (1918-1925) inches
Cow oak	124	1.71	1.35
Cherrybark oak	56	3.28	1.70
Water oak	95	2.67	1.81
Red gum	29	1.86	1.57
White elm	34	1.38	1.02
Winged elm	6	1.90	1.17
White ash	10	2.50	1.82
Green ash	13	1.35[1]	1.43
Black gum	11	1.83	1.43
Nuttall oak	5	2.86	1.40
Honey locust	8	1.81	1.78
Hackberry	2	1.35	1.30
Red maple	8	1.59	1.48

[1]The poor showing made by green ash after cutting was probably due to the fact that nearly all of the trees of this species were semi-suppressed and were in groups not opened up by the cutting.

feet per acre, or 175 board feet per acre per year.

This rate of growth was attained during the first 8 years following a cutting in which the selection of trees to be removed could have been greatly improved and during a period of abnormally high mortality due to drought. It is not to be taken as representative of the full possibilities of growth in selectively cut bottomland stands in the Mississippi Delta.

This study showed that at the time of measurement 74 per cent of the volume of trees 28 inches and over in diameter was in logs of high quality, while in trees under 28 inches in diameter only 44 per cent of the volume was in logs of similar high quality. Under a system of selective cutting taking only the trees from the larger diameter classes, a large proportion of high-grade logs is obtained, while the smaller trees are left to increase both in size and quality.

NATURAL SPREADING OF PLANTED BLACK LOCUST IN SOUTHEASTERN OHIO

By J. A. LARSEN

Iowa State College

This paper presents the results of a study to throw light on various problems relating to the spread of black locust (*Robinia pseudacacia* L.) on southeastern Ohio farmlands. Planting for erosion control, begun many years ago, has been followed by a spread through root suckering at rates varying with local conditions of site and land use between 3.3 and 10 feet a year. The advance was slowest on lands heavily grazed. By planting a square 2½-acre worn-out field or pasture either in 5 parallel strips or in 8 groups, a 6-foot annual advance would obtain a complete coverage in from 7 to 10 years, with a large economy in cost and quantity of planting stock.

DURING the past forty or more years many farmers in Muskingum County and elsewhere in southeastern Ohio have planted locust groves, mainly for gully erosion control. This is in the western part of the Allegheny Plateau region, where the land has been maturely dissected until it consists of variously shaped blocks or remnants of the rough table land. Here and there are narrow ridges and somewhat steep-sided valleys, which have depths up to 300 feet. In most places there is only a narrow bottom or floodplain. The soil was originally a reddish or yellowish slit loam from 6 to 8 inches deep in the A horizon, and a rather heavy silt loam from 15 to 20 or more inches deep in the B horizon.

The main farming practice over this region has been animal husbandry for over 100 years. The continual clean culture of the bared upland, where corn and small grains were raised, and the uninterrupted heavy grazing of the steeper slopes, without semblance of any constructive management of the range, has brought about an accelerated downward wash of surface water from the upland and upper slopes, with deep and long gullies over the pastured areas. The gullies in most instances begin at the lower part of the incline, at points where volume and velocity of the water told disastrously.

In their untutored efforts to prevent further erosion or to control gullying the farmers scattered straw, corn stalks, and brush. Not a few planted locust trees in or adjacent to the gullies. On all these farms, wherever the land has been abandoned or the number of livestock materially reduced the locust trees have spread rapidly and produced fair-sized groves. The spread has been either laterally away from the ravines, or up and down the slopes, or both. Sometimes this has taken place in a circular or fan-wise direction from the centers occupied by the oldest trees.

Because of this tendency of the locust to spread rapidly, many of the farmers who coöperate in the erosion control work of the Department of the Interior in that section show a reluctance to plant this species. They do not know to what extent it will invade a pasture, meadow, orchard, or woodlot. There has been a lack of understanding on the part of those who may be expected to know something about this tree as to the exact manner of its natural extension, whether by seeding or by root suckers. Some have thought that it was necessary to wound the roots in orders to obtain root sprouts or suckers. Nothing at all was

known regarding the actual rate of its spread, or conditions which would hasten or retard this. For these reasons a study in these directions was begun during the summer of 1934.

The method pursued was to observe isolated or rather pure groups of black locust where its migration from one line of the field or from one side or center could be examined. A tape was laid from what appeared to be the oldest tree or trees in the group; the tape being stretched over the ground in a straight line toward the periphery of the stand. With cross-section paper of a convenient scale and a measuring stick the trees were mapped in. Usually all of those on a strip 10 feet wide were recorded and mapped, giving a transect position. The gullies were also measured for width and depth whenever the strip crossed them. The ages and heights of all trees on the strip were carefully noted. Ages were obtained at first by the Madsen increment borer, but in view of the breakage of this instrument in the hard wood the axe proved a vastly less expensive method. Records were also obtained on the nature and density of the surface and shrub vegetation under the locust. In the older groves, where the trees stand rather farther apart than in young stands, many native trees have begun to under-seed. This means of course that, given sufficient time, the native trees will supplant the locust.

It was frequently noted that the roots of the locust trees would extend up and down and across the erosion gullies, and that the trees in these groves tapered off from the larger ones in the center to one- and two-year-old seedlings on the outer edges. Not a few of the younger roots were therefore purposely dug out of the ground. By this means it was proved that black locust trees were more or less

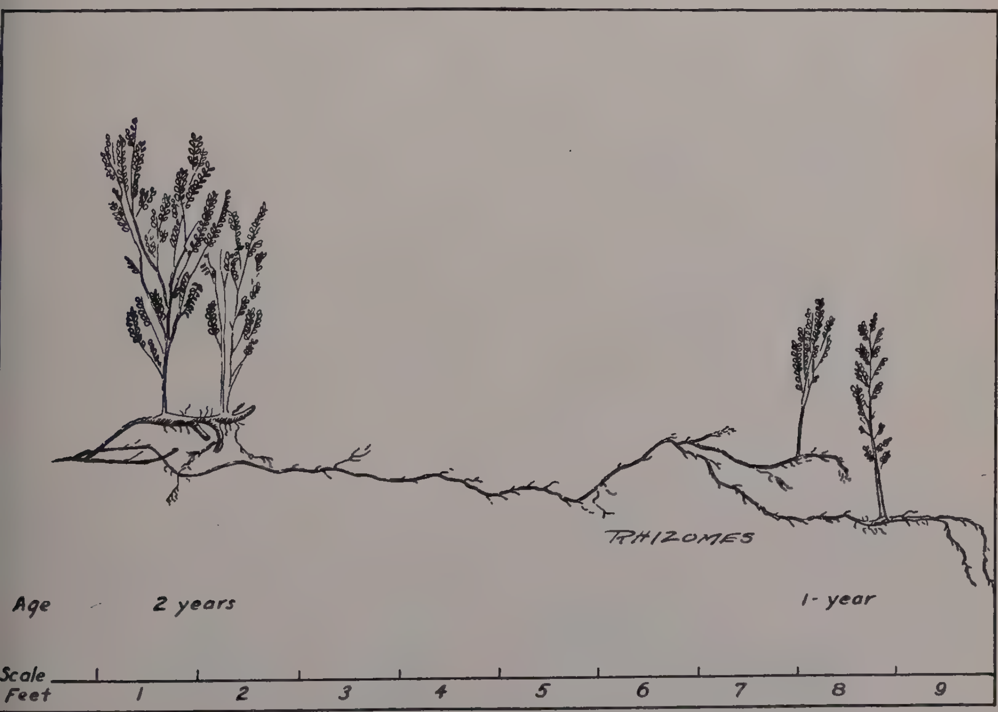

Fig. 1.—Root spread of black locust.

united or connected by the root system. This could be studied best near the periphery of the grove, where it was seen that two or more root suckers were attached to one and the same root. No tap roots were found. Root cuttings from the black locust were made during the summer and planted in agricultural soil in wood boxes. From these several root sprouts arose in less time than one month, but none from the four-year-old root, few on the two-year-old, and several on the one-year-old root.

The more important data obtained were assembled in Table 1.

To obtain the average rate of spread for any one plantation it was necessary only to deduct the age of the youngest trees from the oldest and divide this by the distance in feet.

The figures in Table 1 give a minimum spread of 3.3 feet per year and a maximum of 10 feet. This means the average rate of spread from the center of the group to the last or youngest tree on the outer edge of the grove. In the case of the slowest migration heavy grazing has been the practice. On areas where the grove was spreading at a rate of 8 to 10 feet per year neither cultivation nor grazing had interfered for many years.

Naturally, aside from the interference of cultivation and livestock the rate of spread would be influenced by other factors, such as aspect, gradient, exposure, soil condition, and soil composition or the amount of shale or rock particles present. It cannot be stated that this study has brought these questions to their final answer.

In order to apply this information in the prediction of future spread it was necessary to take a radial distance for the rate of migration and to draw concentric circles on a piece of paper and then calculate the areas represented or covered from year to year. As radial distance one could use any desired figure; in this case an average of 6 was taken. The results are listed in Table 2.

It is seen in Table 2 that the area which will be covered by the spreading of black locust from year to year increases at a geometric ratio. Using 6 feet as a rate and selecting an area 330 by 330 feet, the locust planted on one side would be expected to cross over to the other side in about 55 years; if both sides were planted at the same time, the time required for complete coverage would be reduced to 27 years. Now if several intermediate strips were set out, the time needed for coverage would be still further reduced. Three intermediate strips and two sides of such a field would mean a period of about 7 years. On the other hand, if we consider the spread to take place from one central group of trees on an area 330 by 330, or 2.5 acres, the trees should reach the outer edges in about 27 years. If four groups could be planted equidistant from each other and from the borders, the same field

TABLE 1

RATE OF SPREAD OF BLACK LOCUST PLANTED FOR GULLY CONTROL

Plantation	Age of oldest tree	Surface condition	Maximum spread, feet	Hindrance to spread	Average rate, feet
1	5	gentle, moist	46	light grazing	9.0
2	5	gentle, moist	34	light grazing	8.5
3	5	gentle, moist	37	light grazing	10.0
4	5	gentle, moist	22	light grazing	8.0
5	17	rolling, dryer	60	medium grazing	4.0
6	17	rolling, dryer	100	medium grazing	6.0
7	31	rolling, dryer	100	heavy grazing	3.3
8	55	rolling, dryer	198	heavy grazing	3.9

hould be filled in about 14 years. Eight uch groups would reduce the time to 10 ears.

Hence it will be unnecessary to plant field completely with locust trees, but he planting may be concentrated wherever there is active erosion, leaving the emainder of the field to fill in naturally, hereby reducing the expense.

In conclusion: black locust planted for gully erosion control on farms in southeastern Ohio spreads by lateral extension of the roots under ground and propagates itself by root suckers. Black locust will spread up and down slopes, across eroding gullies, through loose shale and rather hard sub-soil, and go below the deep ravines caused by the erosion. Wounding of the roots is not necessary in order to encourage root suckers, but the species does not invade the native woodlots or areas covered by dense brush.

TABLE 2

AREA INCREASE FROM YEAR TO YEAR BY PLANTING 1 GROUP AND 10 GROUPS OF BLACK LOCUST

Years after planting	Radius, feet	Area, sq. ft.	Annual increase, sq. ft.	Annual increase, 1 group	Annual increase, 10 groups
3	18	1,027	575	1/40 acre	1/4 acre
7	42	5,539	1,469	1/30 acre	1/3 acre
10	60	11,204	2,048	1/20 acre	1/2 acre
14	84	22,156	3,052	1/15 acre	
20	120	45,216	4,408	1/10 acre	1 acre

TREES AND THE WHITE GRUB MENACE[1]

By PAUL O. RITCHER and C. L. FLUKE, Jr.

University of Wisconsin

DAMAGE to pastures and cornlands of late years by white grubs has been widespread in several states and has been easily recognized. It is still a common impression that this havoc is the result of the feeding of just one kind of white grub, which develops into only one kind of June beetle. However, our various injurious white grubs belong to over 100 species, of which at least 25 infest Wisconsin.

Each of these species differs in some of its habits from every other species. Some adults fly to lights, some do not, some can not even fly. Some kinds take two years to mature, some three, and some four. Some prefer one type of soil and some another. Some prefer certain trees for food, some prefer grasses.

It has been found by workers in several states that where certain food plants such as oaks abound, there species preferring those particular hosts multiply and cause enormous amounts of damage. Other June beetle species, although able in some cases to make adjustments to other food plants, are restricted in numbers because of the scarcity of their preferred food plants. It would appear that a correlation exists in nature between the food plant on the one hand and the June beetle and subsequent grub damage on the other.

In Wisconsin, according to Zon (3), the lower half of the state is characterized by an oak forest interspersed with prairie in the southern part. This area coincides closely with the estimated areas of worst grub damage. If more detailed knowledge of the distribution of the insect were available, the two areas would probably show an even greater correlation.

Most of the damage to Wisconsin pastures and cornlands is caused principally by the grubs of four species of June beetles, *P. fusca, rugosa, hirticula,* and *tristis,* all of which have oak preferences. In areas where oaks are wanting and replaced by other hosts, little damage occurs. As for other states where oaks are common, Forbes (1) in making food plant collections from 1907-1913 noted a marked preference for oaks by these and other species. In Iowa, Travis (2) collected 51,049 June beetles in 1932 from 18 hosts. Of this number 43,932 were taken from oaks.

Further than this, there is a marked preference among certain species of June beetles for certain varieties of oak, notably bur oak. This is the tree that is most often completely stripped of its leaves in Wisconsin and the one which is by far the most dangerous of all the oaks from the standpoint of increased grub damage.

Of the 43,932 beetles collected by Travis on oak trees in Iowa mentioned above, 43,029 were taken on bur oak. Forty-two thousand, eight hundred and eighty-one of these indivdiuals belonged to *P. hirticula, tristis,* and *fusca,* the same species so injurious in Wisconsin in territories where oaks are found. In collections made on bur oak in Wisconsin by

[1]Published with the permission of the Director of the Wisconsin Agricultural Experiment Station.

Fluke and Ritcher in 1934, 98 per cent of the beetles belonged to these species!

Forbes (1) makes mention of similar varietal preferences in Illinois. He says he does not have enough data to make sufficient mention of the various species, but some of his most experienced and observant collectors say that oaks with rounded lobes (bur and white) are much more resorted to than red or black.

The value of such studies as these and the need for more is emphasized when the time comes for the choice of trees for planting either on a small scale or on a gigantic scale. To keep white grub population and damage at a minimum one must consider carefully varieties of trees and their relative attractiveness as June beetle food.

In the first place, the choice of trees should be considered from the standpoint of the successful establishment of the young trees themselves. In Wisconsin large numbers of our oaks are dying due to a complication of things, not a minor part of which is all too frequent defoliation by the hordes of June beetles.

In the second place, this should be carefully considered: will the introduction or increase in numbers of this particular tree make possible the increase of harmful species of insects such as white grubs? The same extremely harmful species of June beetles found in Wisconsin, which have predominant oak feeding preferences, are now present in small numbers in other states where oaks are scarce.

In the third place, it is highly probable that the present injury by white grubs in such localities as southern Wisconsin could be reduced by the elimination of bur oaks in those areas and the propagation of other species of trees not desirable for adult beetle food. This is not an impossible task, even though a number of years would be involved in the change.

References

1. Forbes, S. A. 1916. A general survey of the "May beetles" (*Phyllophaga*) of Illinois. Ill. Agr. Exp. Sta. Bull. 186.

2. Travis, B. V. 1933. Notes on the habits of June beetles in Iowa (*Phyllophaga*). Iowa State Coll. Jour. Sci. 7:397-406.

3. Zon, Raphael, and others. 1932. Forest land use in Wisconsin. Rept. of the Committee on Land Use and Forestry, p. 15.

BRIEFER ARTICLES AND NOTES

S. A. F. Takes Action on Proposed Additions to Grand Teton National Park

From the standpoint of nationally planned land use, the question "What kinds and types of land and what specific areas properly belong in the national park system?" is an important one. Like the question "What is forestry?" it has never been decisively answered, although numbers of interested individuals and groups have written their own variant and sometimes conflicting definitions. It has been before the Society of American Foresters more than once in the past several years, but no official action has, until now, ever been taken, except that five years ago at the annual meeting in Washington a resolution endorsing the proposed Everglades National Park in Florida was introduced and hastily adopted during the closing moments of the session.

The Council of the Society, in its recent action on the proposed additions to the Grand Teton National Park, as explained in the following interchange of letters with Senator Carey of Wyoming, has broken new ground toward development of a carefully thought-out consensus of opinion on the subject among professional foresters.

It might be mentioned that when the Bill, S. 3705, was before Congress last winter, the National Park Service endorsed it; the Forest Service interposed no objection; the American Forestry Association, by a bare majority vote of its directors, approved it; and the National Parks Association alone opposed it.

Franklin Reed,
Managing Editor.

April 5, 1935.

Honorable Robert D. Carey,
Senate Office Building,
Washington, D. C.

My dear Senator Carey:

I am advised that you have under consideration reintroducing in this Congress Bill S3705 of the last Congress providing for certain additions to and extensions of the Grand Teton National Park. Possibly the position of the Society of American Foresters in this matter will be of interest to you.

Through action by its Council, it has expressed itself as being opposed to the additions to the Park as outlined in the above mentioned Bill on the following grounds:

1. They would include Jackson Lake and the smaller lakes to the northeast, all of which are now used for the commercial purpose of irrigation.

2. They would include the lands now owned by the U. S. Government and administered by the U. S. Biological Survey for the purpose of raising hay to winter the southern elk herd. This is not a national park use.

3. They place within the Park boundaries the entire valley controlling commercial access to the western slopes of the Teton National Forest.

4. They will seriously interfere with the sound plan of game management for the southern elk herd by restricting the normal kill on portions of the national forest and interfere with the plan for winter feeding.

5. The lands included in the proposed

additions lying east of Jackson Lake and the Snake River are open desert or sage brush lands of no park value and not needed for purposes of park administration.

One of the arguments in favor of the proposed additions is that they include some 40,000 acres of land purchased by John D. Rockefeller, with the intention of giving it to the government for public use. This use could be better fulfilled if they were made a part of the adjacent national forest or added to the Biological Survey reserve. Another argument in favor of the proposed additions is that the entire area surrounding Jackson Lake should be treated as a park and all commercial use prohibited. The answer to that is that this lake has already been developed for irrigation purposes and therefore cannot be devoted exclusively to park use.

The Society of American Foresters is in agreement with the National Parks Association that it would be right and proper to extend the Grand Teton National Park boundaries northward on the west of Jackson Lake to join Yellowstone National Park but such extension of boundaries is not proposed in the above mentioned Bill.

The professional foresters of the country have always appreciated and upheld the basic distinction between national parks and national forests and they stand ready, through their professional society, to continue to do so.

If it would be of any aid to you, I would be glad to call upon you at your convenience and explain to you more in detail the reasons for the Society of American Foresters' opposition to this measure.

Very sincerely yours,

FRANKLIN REED,
Executive Secretary.

[1]Junior Member, S. A. F., 1933.

April 10, 1935.

Franklin Reed, *Executive Secretary,*
Society of American Foresters,
Washington, D. C.

MY DEAR MR. REED:

I was very glad to receive your letter of April 5 in which you set forth the views of your Association as to the extension of the Grand Teton National Park.

To make my position clear I desire to state that I have never favored any extension of the present park boundaries and that my sole purpose in introducing the measure at the last session of Congress was in an endeavor to bring about the settlement of what appears to be an endless controversy. Were I certain that the extension of the Park along the lines suggested in your letter would settle this controversy nothing would please me more.

I shall not take time to discuss the various factors entering into this matter but will be glad to see you or any other representative of your organization and discuss the problem with you.

I have not reintroduced the bill at this session as I have been hoping that certain differences might be ironed out.

Very truly yours,

ROBERT D. CAREY,
Committee on Appropriations,
U. S. Senate.

A PROFESSIONAL FORESTER IN RECREATIONAL PLANNING

Further evidence of the systematic manner in which the National Park Service is going about its Emergency Conservation Work program is found in the assignment of Fred H. Arnold,[1] as forester for the State Park Division of the National Park Service under the immediate supervision of Assistant Director Conrad

L. Wirth, in charge of the Branch of Planning. His duties will be to coordinate the forestry policies in the Civilian Conservation Corps state park project with the forestry policies of the National Park Service, through cooperation with John D. Coffman, Chief of the Branch of Forestry. He will be responsible for the correlation of all forest and fire protection activities in the state park program and the supplying of technical advice to state park E.C.W. field officers in matters pertaining to forestry and forest fire prevention.

These regional officers are located in Springfield, Mass., Bronxville, New York, Richmond, Va., Atlanta, Indianapolis, Oklahoma City, Omaha and San Francisco.

Mr. Arnold graduated from the N. Y. State College of Forestry in 1928 with a B.S. Degree and in 1932 received his Master's Degree in forestry.

He has been connected with the Red House, New York, Forest Experiment Station, the U. S. Forest Service, the Third Regional Office in Albuquerque, New Mexico, and the Northeastern Forest Experiment Station in New Haven, Conn. He was also with the N. Y. State Department of Public Works, Division of Highways, the Maurice L. Condon Tree Expert Company of White Plains, New York, the Eastman Kodak Company and the Outpost Nurseries, Inc., Richfield, Conn.

Just prior to joining the state park division, he was in the National Park Service as an E.C.W. assistant supervisor with administrative responsibility for the work of the Conservation Corps in eastern national parks and monuments.

This movement into which Mr. Arnold has been brought has in the two years of Emergency Conservation Work established itself as one of the most popular and important phases of the Administration's recovery program. At first there were 105 C.C.C. companies on state park projects in 26 states. Under the proposed expansion program, there will be 481 in 42 states. The little group set up to direct the work of the Conservation Corps in the state parks, has, in two years grown from one room in the Interior Building to cover three floors in the Bond Building.

The states are taking advantage of the situation. In the two years they have provided 457,000 acres for park development, bringing the nation's total state park acreage to 3,500,000, an area nearly as large as New Jersey.

Legislatures are planning to set up park authorities to administer and maintain what E.C.W. has provided. The National Park Service is cooperating in long-range state and regional planning.

FANNING HEARON,
National Park Service.

BARK THICKNESS

Bark thickness varies with species and with age, site, and stand density. In Table 1 average bark thickness at 1 foot and at 4½ feet above ground level are given for 10 different species of forest trees. These data were collected during the progress of oak (2) and Virginia pine (3) studies and are mean values for stands of many ages and sites.

A Swedish bark instrument was used to obtain bark thicknesses. Maximum deviation for a single species did not exceed 12 per cent and aggregate deviation 1 per cent. Less variation was evident at 4½ feet than at 1 foot. These data are for single bark thickness.

Smooth patches (1, 6) were evident on many of the white oaks in the larger diameter classes, and for this reason normal bark thickness may not have been secured in these species.

The insulating properties and thickness

of bark reflect fire resistant capacity of a species (4, 5). With all species bark thickness increases as diameter of bole increases. Young trees succumb to fire injury much more readily than do older and larger trees because they have a thinner bark. Starker (5) has pointed out correlation between bark thickness and the relative fire resistance of species in different regions.

Fires in mixed oak and pine forests often kill all of the hardwoods, while none of the conifers are killed. The tables show that the bark of the pines is more than twice as thick as that of the other species. The bark of red maple is the thinnest of the species studied. Fire studies indicate that this species suffers greater injury and loss than do any of the oaks or pines.

TABLE 1

TREE BARK THICKNESS, PENNSYLVANIA, 1934

Species	Tree diameter at breast height (d.b.h.) inches																			Basis number trees
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Thickness of bark at breast height. Inches																				
White oak	.16	.22	.26	.29	.31	.34	.37	.39	.41	.43	.45	.47	.49	.51	.53	.55	.57	.59	.60	201
Chestnut oak	.15	.22	.29	.36	.42	.48	.54	.60	.65	.70	.75	.81	.86	.90	.94	.97	1.00	1.02	1.04	311
Black oak	.12	.18	.25	.31	.37	.42	.48	.52	.56	.60	.64	.68	.71	.75	.78	.82	.86	.89	.92	176
Red oak	.10	.15	.20	.25	.29	.34	.38	.43	.47	.51	.54	.58	.62	.65	.69	.72	.76	.79	.82	223
Scarlet oak	.11	.16	.21	.25	.29	.33	.37	.41	.45	.48	.52	.55	.59	.62	.66	.69	.72	.76	.79	252
Red maple	.07	.10	.12	.15	.18	.21	.24	.27	.29	.32	.34	.36	.38	.39	...	...	...	...	...	66
Black locust	...	...	.35	.41	.47	.52	.57	.61	.65	.69	...	...	...	...	...	...	...	...	...	61
Virginia pine	.19	.28	.36	.45	.54	.62	.70	.78	.85	.92	.98	1.04	1.09	1.13	1.17	1.20	...	...	...	388
Mountain pine	.29	.46	.61	.76	.91	1.40	1.18	1.31	1.45	1.58	1.71	1.84	1.96	...	...	...	...	...	...	148
Pitch pine	.19	.36	.54	.72	.89	1.60	1.21	1.36	1.40	1.63	1.74	...	...	...	...	...	...	...	...	126
Thickness of bark at one foot above ground level. Inches																				
White oak	.19	.25	.31	.35	.40	.44	.48	.52	.55	.58	.61	.63	.65	.67	.69	.70	.70	.71	.71	201
Chestnut oak	.23	.33	.41	.49	.56	.63	.70	.76	.82	.88	.93	.97	1.00	1.01	1.01	1.02	1.02	1.02	1.02	311
Black oak	.20	.30	.39	.46	.53	.59	.63	.67	.70	.72	.74	.76	.78	.80	.82	.84	.86	.87	.87	176
Red oak	.18	.27	.35	.42	.49	.55	.59	.64	.68	.72	.75	.78	.80	.82	.83	.83	.84	.84	.84	223
Scarlet oak	.17	.25	.33	.39	.46	.52	.57	.62	.66	.70	.74	.77	.79	.81	.83	.84	.85	.85	.86	252
Red maple	.09	.13	.17	.21	.25	.29	.32	.36	.39	.42	.44	.46	.48	.49	...	...	...	...	...	66
Black locust	...	...	.36	.42	.49	.61	.74	.84	.91	.97	1.01	...	...	...	...	...	...	...	...	61
Virginia pine	.36	.57	.76	.93	1.08	1.21	1.33	1.43	1.52	1.61	1.67	1.73	1.78	1.82	1.86	1.88	...	...	...	388
Mountain pine	.58	.78	.96	1.12	1.27	1.42	1.55	1.69	1.82	1.96	...	...	...	...	...	...	...	...	...	148
Pitch pine	.41	.64	.86	1.06	1.24	1.41	1.56	1.68	1.80	1.90	1.99	...	...	...	...	...	...	...	...	126

REFERENCES

1. Craighead, F. C. 1933. Jour. For. Vol. 31:6, p. 720.
2. McIntyre, A. C. 1933. Growth and yield in oak forests of Pennsylvania. Pa. Agr. Exp. Sta. Bul. 283.
3. ———. 1933. Virginia pine in Pennsylvania. Pa. Agr. Exp. Sta. Bul. 300.
4. Nelson, Ralph M., Sims, Ivan H. and Abell, Margaret S. 1933. Basal fire wounds on some

southern Appalachian hardwoods. Jour. For. Vol. 31:7, pp. 829-837.
5. Starker, T. J. 1934. Fire resistance in the forest. Jour. For. Vol. 32:4, pp. 462-467.
6. Tehon, Leo R. and Jacks, W. R. 1933. Smooth patch a bark lesion of white oaks. Jour. For. Vol. 31:4, pp. 430-433.

Results of 1924 Cleanings of Cove Hardwoods, Pisgah National Forest

In the 10 years since cleaning, a young cove hardwood stand at Lookingglass Rock, Pisgah National Forest, has shown an increase of 143 desirable[1] dominant trees per acre. Nearby untreated plots show an increase for the same period of only 89 desirable dominant trees per acre.

These figures are taken from the records of four plots established by the Appalachian Forest Experiment Station in 1924. The area upon which these plots are situated originally supported a heavy stand of cove hardwoods scaling over 40 M per acre, more than half of which was yellow poplar. The area was practically clear-cut in 1913, and abundant reproduction followed. In May, 1916, a severe fire killed back the reproduction of all species and nearly all of the fairly abundant advanced growth.

The area came back heavily to sprout growth of silverbell and chestnut, with seedlings of sumach and yellow poplar. Yellow poplar was soon overtopped by the other species. In 1924, four half-acre plots were established. Plots 1 and 2 received no treatment; on Plot 3 chestnut, silverbell, and dominant sumach were cut; while on Plot 4 only chestnut and silverbell were removed.

Leaving the sumach on Plot 4 did not result in any significant retarding of growth on other trees. The sumach was allowed to remain on this plot at the time of cleaning, on the basis that it cast only light shade and would be short lived. By 1928 the number of sumach on Plots 1, 2, and 4 had been greatly reduced through natural causes, and by 1933 there were approximately only 3 dominant and co-dominant sumachs per acre.

The cleaned plots not only had greater increase in number of desirable dominants of all crown classes, but they also showed a larger increase in the proportion of desirable species in the dominant canopy. In 1924 both treated plots had a lower percentage of desirables in the dominant canopy than did the untreated, but by 1933 this condition was reversed. The increase in percentage of desirable dominants for the period 1924-33 was 69.5 per cent on the cleaned plots and 47.5 per cent on the untreated plots.

When desirable stems (1.6 inches d.b.h. and up) in all crown classes are considered, the untreated plots gained an average of 134 stems per acre from 1924 to 1933, while the combined treated plots showed an average increase of 323 desirable stems per acre.

In addition to the greater increase in number of desirable trees, the cleaned plots showed better diameter growth. The increase in average d.b.h. of desirables for the 10-year period was 1.67 inches on the treated plots, and 1.40 inches on the untreated. The greater increase on the treated plots was made upon 223 more desirable trees per acre than existed upon the untreated plots in 1933.

This greater number of faster growing desirable stems following early treatment

[1] Desirable consisted of yellow poplar, black locust, red oak, chestnut oak, basswood, cucumber, ash. Species considered undesirable were silverbell, chestnut, sumach, mountain magnolia, sourwood, dogwood, fire cherry, mulberry, hickory, red maple, striped maple, sassafras.

enhances the possibilities of profitable thinning in the future because of the greater volume of desirable species per acre that will be available for removal. In the present case this is particularly true, for many of the desirables are yellow poplar and black locust, usable in small sizes for pulpwood and posts, respectively. Also, at the time of thinning, treated areas will have more desirable trees from which the best may be chosen for final crop trees. Greater freedom in spacing will be possible.

Charles A. Abell,
Appalachian Forest Exp. Sta.

Forest Nursery Seedlings Subject To Arsenical Injury in Some Soils

The unprecedented demand for forest-tree seedlings to meet the requirements for such government agencies as the Tennessee Valley Authority, the Soil Erosion Service, and the Forest Service in carrying out their extensive planting programs has necessitated the enlargement of existing forest nurseries and the establishment of many new ones. In selecting new areas for nursery sites, it sometimes becomes necessary to include grasslands, or open woodlands in which grass occurs. Frequently such areas are infested with white grubs, the young of May beetles. Consequently, when seed beds are prepared on new ground without precaution, such as steam sterilization, fumigation, etc., being taken to free the soil of such pests, severe injury is liable to result and often is quite noticeable the first season. This is particularly true where the nursery is established the year following a heavy flight of beetles, since the grubs are known to be voracious feeders during their second season, and especially for the typical three-year forms, which are abundant over most of the northern sections of the country. In the extreme North the life cycle is lengthened to four years, and in the South, with some species, it is shortened to two years or less.

Control of grubs throughout the season is possible by means of soil fumigants, but costs are prohibitive, especially under conditions where the grubs are present in large numbers. For this reason, in coöperation with the Forest Service, a series of soil-poisoning treatments was arranged to determine the effectiveness of certain chemicals in protecting seedlings from these pests. It was believed that such treatments would be practical inasmuch as a single application might suffice for one or more seasons, and the cost thereof, in the form of materials and labor, would be small. These tests have been in progress since the spring of 1930 in the federal nursery in Nebraska[1] and since 1932 in the three state nurseries in the Carolinas. At the time the tests were begun, little information was available relative to the effect of various chemicals on germinating and first-year seedlings. Inasmuch as lead arsenate was used so successfully against the Japanese beetle in freeing the soil from their destructive grubs, this chemical was among the first used in the present tests for the control of larvae of the May beetles. Such procedure also was in conformity with recommendations frequently made for the control of white grubs in forest-nursery practice. However, these recommendations for the control of the Japanese beetle grubs were for the treatment of mature established plants and no information was available on the effect of the treatment on the

[1]The tests in Nebraska have been conducted under the supervision of L. G. Baumhofer of this Bureau and those in the Carolinas by the writer, assisted by H. R. Johnston.

germination and development of forest-nursery seedlings.

Arsenic in the form of acid lead arsenate and crude white arsenic was used, but most of the tests were made with the former chemical. The latter was used only during the initial application in the Nebraska nursery. In general the arsenic was applied by mixing it with sand or manure before working it into the soil to a depth ranging from 2 to 10 inches in the various experimental beds. This was done in the early spring just prior to planting. Beds were treated which were subsequently sown or transplanted to such species as pine, red cedar, locust, and walnut.

The soils in all four nurseries consist mainly of light sandy loams. Those in the Coastal Plain region of the Carolinas are somewhat acid, ranging in p^H value from 4.8 to 5.6. That in the Sandhill region in Nebraska is nearly neutral, being close to 7.

Although no definite statements can be made or conclusions drawn until the tests have been completed, it is believed that a brief preliminary announcement should be made, setting forth some of the more important indications of results, before the spring planting season begins; it is believed that this information will be helpful to foresters and others interested in the production of seedlings.

(a) Arsenic, in the form of lead arsenate or white arsenic, should not be used until more experimental work is done, because severe injury has resulted to seedling and transplant stock, such as pine, locust, walnut, and red cedar.

(b) Arsenic appears to affect seriously germination and to stunt the growth of plants.

(c) The degree of injury varies with the species, age of the plant, dosage of the chemical, and the soil.

(d) In some soils arsenical injury may not become apparent until after the first season and may persist for a number of years.

R. A. St. George,
Bureau of Entomology and Plant Quarantine.

Buckwheat as an Indicator of the Relative Nitrogen Requirement of Conifers

Information as to the relative nitrogen requirement of certain coniferous trees was attained on some commercial fertilizer plots laid out in 1931 by the New York Conservation Department at their Saratoga Nursery. Buckwheat, sown as a cover crop on the area, following the removal of the trees, indicated by its color the relative amount of nitrogen extracted by the various tree species.

The soil on the area is a loamy sand, with 11 per cent of "total colloidal" material and a pH of 5.6. The area previous to 1928 was used for farming, but for several of the later years had been abandoned. In 1928 the land was partly cleared of brush, plowed, and planted to two-year old northern white cedar after a light application of farm manure. The cedar remained through 1929 as four-year transplants. In the spring of 1930, after the removal of the trees, the land was plowed and sown with field peas after an application of 8-6-6 fertilizer at the rate of 500 pounds per acre and 1,000 pounds of limestone per acre. The peas were plowed under in the fall of 1930, and in the spring of 1931 the above mentioned plots were established. The series consisted of 180 plots, each 12 by 12½ feet, with 1,200 trees per plot. Five tree species were used, with eight treatments and a control and with four replications of each treatment and species.

Each replication of a particular species consisted of nine plots, three each way and forming nearly a square 42 by 43½ feet, including the paths. Each such replication was scattered at random throughout the area in order to compensate for variation in site, time of planting, etc. The treatments consisted of "complete" commercial fertilizers, along with those fertilizers containing phosphorus, potassium, nitrogen, and limestone only. The treatments were applied immediately before transplanting. Various measurements were made of the trees produced on the different plots at the end of the first and second years. These results remain to be published. After the removal of the trees in the spring of 1933, the whole area was sown to Japanese buckwheat on June 10th.

On August 2nd an examination of the areas revealed a very striking color variation in the foliage of the buckwheat, which was then about 2 feet high and just starting to bloom. Close examination showed that the different shades of buckwheat varied from normal green to yellow and that the colors were confined to certain blocks. These blocks were found to be related to the tree species previously planted on the blocks. The shades of buckwheat as related to the tree species were as follows:

TREE SPECIES PREVIOUSLY PLANTED	COLOR OF BUCKWHEAT FOLIAGE
White pine	Normal green
Red pine	Normal green
White spruce	Light green to slightly yellow
Norway spruce	Light green to slightly yellow
White cedar	Distinctly yellow

The color of buckwheat for any one species was found to be consistent throughout the four replications. There could be observed no reaction from the previous fertilizers applied to the trees within each block.

A nitrogen deficiency was suspected as being the cause of the yellowing of the buckwheat, and was so proven by a light application of sodium nitrate to part of one block which had been previously planted to white cedar. Six days after the application, the buckwheat had turned to a normal green color.

Thus, the rapidly growing buckwheat served as an indicator of the nitrogen requirement of the tree species used. White cedar apparently demands the most nitrogen, followed by the spruces and then the pines.

E. J. Eliason.

Biennial Report for Hawaii

Hawaii, although separated by half an ocean from the Continental United States, suffered in 1933-34 from the same problem of forest administration common to the North American states, namely—lack of funds. Appropriations to the Division of Forestry were reduced, during that biennium to $65,800 as compared with $260,165 in the 1931-33 period. It was necessary to cut the working force from 87 trained and experienced men to 18, which necessitated a drastic curtailment of all forestry projects.

The delay occasioned by getting trucks and equipment for the E.C.W. program held up the start of that work until April, 1934, when a force of 555 men was enrolled. The E.C.W. has done much to alleviate the stress of reduced appropriations, but Territorial Forester C. S. Judd recommends the appointment of at least eight more rangers to supplement the five who now have charge of the government's 670,527 acres.

During the biennium a total of 37,882 destructive wild animals (goats, pigs,

cattle, and sheep) was eradicated, 19 miles of new fences were built, more than 1,728,000 trees were produced in the five nurseries, almost 1,190,000 trees were planted, and 70 miles of new foot-trails were constructed. Fire damage was confined to 668 acres.

Tabulated lists of the biennial accomplishments, included in the report, give the reader a picture of maximum usage of a meagre allotment.

ALBERT G. HALL.

RELATION OF SUNLIGHT TO RATE OF GROWTH

Studies of the role of sunlight in growth and development of forest trees under natural conditions are usually complicated by an uncertain variable in soil moisture. Clements and Long[1] have recently announced the results of an experiment that helps to clarify the haze surrounding this subject. Although they worked with sunflower plants instead of forest trees, the findings are undoubtedly applicable to trees. Sunflowers were grown in sealed pots (phytometers) in full sunlight and under lath shades which reduced insolation to 32, 16 and 8 per cent of full sunlight. In each of the four degrees of insolation there were four grades of soil moisture (holard), namely, 35, 26, 18 and 13 per cent of the dry soil weight.

Photographs and tables show clearly that the largest and strongest plants are those grown in full sunlight accompanied by an abundant supply of moisture (35 per cent). A reduction of insolation results in increased height of stems, but at the expense of diameter growth and leaf development. Plants grown in less than 32 per cent light are very slender and spindling, regardless of the moisture supply.

The authors summarize their conclusions in this statement: "The results obtained indicate that water assumes the major role in stem elongation, and light the larger part in the production of dry matter, the two necessarily cooperating in the adaptation characteristic of shady habitats." In all four light series, where the insolation remains constant but the moisture varies, height growth increases greatly with each increase in moisture supply. Diameter growth also increases with moisture but in less degree than height. Where moisture remains constant, with insolation as a variable, the reduction from full sunlight to 32 per cent is accompanied by a sharp increase in height of the stem; but below 32 per cent the height remains nearly constant until the lowest degree of insolation is reached, when the height declines slightly. This increase in height of stem is accompanied by a decrease in diameter, with the result that the plant attains an extremely slender form. These effects are best expressed by total dry weight. Giving the plants grown in full sunlight and with 35 per cent moisture a relative weight of 100 per cent, the decline with a decrease of moisture is as follows: 26 per cent moisture, 75 per cent weight; 18 per cent moisture, 40 per cent weight; 13 per cent moisture, 12.3 per cent weight. Applying a similar comparison where moisture is kept constant but insolation reduced, the following relation was obtained: full sunlight, 100 per cent weight; 32 per cent sunlight, 33 per cent weight; 16 per cent sunlight, 9.4 per cent weight; 8 per cent sunlight, 4.4 per cent weight.

Experiments by the Southwestern Forest and Range Experiment Station with

[1]Clements, Frederic E., and Long, Frances L. Factors in elongation and expansion under reduced light intensity. Plant Physiology, 9:767-781. Illus. 1934.

ponderosa pine under lath shades in the Fort Valley nursery have given results which agree in general with those obtained by Clements and Long. Where the insolation was reduced to 50 per cent of full sunlight, the stems at the end of 5 years had only about one half the diameter of those grown in full sunlight, although height growth, instead of increasing, decreased slightly. As in the sunflowers, the effect was to produce a slender stem. Pines planted in 10 per cent of full sunlight all died during the first winter. Of those planted in 20 per cent of full sunlight more than half died during the first winter, and the survivors at the end of 5 years were very much below normal in both diameter and height.

G. A. PEARSON,
S. W. For. and Range Exp. Sta., U. S. Forest Service.

A REVISED LIFE-ZONE MAP OF CALIFORNIA

A complete revision of the life-zone map of California has been completed by Dr. Joseph Grinnell of the University of California Museum of Vertebrate Zoology. This is the first revision of this map since the same author's map of 1913. The revision is based upon much new information obtained by Dr. Grinnell on his own travels and from the publications of other field workers.

The map is drawn to small scale and appears in University of California Publications in Zoology Volume 40, No. 7, January 16, 1935. It is available from the University of California Press at 25 cents per copy.

ERRATUM

Mr. H. W. Shawhan, Director of Conservation of West Virginia, has called to my attention corrections which should be made in the Committee Report on State Forestry Organizations, as printed in the March, 1935, issue of the JOURNAL OF FORESTRY. The following corrections should be made in Table 4, Page 289, opposite West Virginia. Under column headed, "Chief Executive Qualifications," substitute for the word "none," the following, "training, experience, capacity and interest in the activities embraced within the department."

Under column headed, "Authority of Commission," the word "full" should be changed to "advisory." Under column headed "Forestry Executive, Appointed by," change the word "Commission" to "Director." Under column headed, "Forestry Executive, Technical training," substitute for "Not specified" the following, "The Director shall appoint the heads of the divisions of the department and shall employ such assistants and employees as may be necessary to the efficient operation of his department." The Director has appointed a technically trained forester as head of the Division of Forestry.

ROBERT M. ROSS,
For Committee on State Forestry Organizations.

REVIEWS

Artificial Pruning in Coniferous Plantations. By Ralph C. Hawley and Robert T. Clapp. *Yale University School of Forestry, Bulletin 39. 36 pp., 10 pl. 1935.*

Pruning of white pine has been practiced on a small scale in various parts of New England for at least 40 years (for example, by Morton in Massachusetts; Pratt and Knapp in New Hampshire). Until recently, however, artificial pruning was looked upon as too intensive a measure for serious consideration in American forestry. Even as late as 1927, Moon and Brown stated that "pruning is an extremely expensive procedure—should be classed as an æsthetic, rather than economic measure." Nevertheless, they did suggest that pruning of the lower branches from 100 of the best trees in white pine stands, at a cost not over $2 to $3 an acre, might be profitable.

Within the last 10 years foresters have commenced to recognize that pruning is an essential step if second growth forests, managed on short rotations, are to yield an appreciable amount of clear lumber. This is especially true of such species as white and loblolly pine and spruce, and probably also of Norway pine, particularly where these are planted in pure stands. European experience indicates that Douglas fir in pure stands also requires artificial pruning.

Hawley and Clapp now go so far as to say: "Unless a plantation of white pine is systematically pruned, thinned, and protected against injurious agencies, it is doubtful whether the original expense of establishing the plantation can be justified on the basis of the timber crop which will be grown."

Their bulletin, which is based on work done in plantations of white and Norway pine and Norway spruce near New Haven, describes in detail the technic of pruning and presents data on the costs and the physical results of the operation. They recommend pruning of 150 to 200 trees per acre at a cost of $16.65 to $22.20 for white pine and somewhat less for Norway pine. (Cline and Fletcher suggested 150 to 300 trees, at comparable costs.) Pruning should be supplemented by frequent thinnings, in order to increase the diameter growth of the final crop trees.

There are not yet sufficient data for final conclusions as to the financial aspects of pruning. However, on the basis of assumptions which they believe to be conservative, the authors agree with Cline and Fletcher and others that properly pruned and thinned stands may be expected to yield a reasonable return on the cost of the operation.

W. N. Sparhawk,
U. S. Forest Service.

A Program for Land Use in Northern Minnesota. By Oscar B. Jesness, Reynolds I. Nowell, and Associates. *Univ. of Minn. Press, 1935.*

This book, appearing less than a year after Land Utilization in Minnesota: A State Program for the Cut-Over Lands, is explained by the authors as presenting the results of specific research study in the field of land utilization, in contrast with the earlier volume which constituted the report of a special committee ap-

pointed by the Governor of Minnesota, and which had drawn upon earlier research studies for most of its material. This later volume deals with present land use and future land use plans in fourteen counties in northeastern Minnesota. Chapters and parts of chapters represent the individual contributions of numerous members of the staffs of the University of Minnesota and of the U. S. Department of Agriculture.

The book presents in orderly sequence a description of the region, the present uses of land in eight "natural" areas into which the region is divided, the economic consequences of planless land use, and existing policies affecting land use now being pursued by governmental agencies. Making a strong case for a new order in land planning, the authors proceed to discuss the practical application of land planning as represented in rural zoning, better utilization of private forest lands, an expanded program of land acquisition by the state and federal governments, better agricultural practices on land now in farms, and new adjustments which are believed feasible in the matters of settler relocation and governmental organization affecting counties, towns, and school districts.

The book is specific to a degree that is stimulating. Take for instance, the matter of rural zoning. It is frankly recognized that land planning in itself cannot accomplish much; that governmental authority represented by that form of the police power known as zoning needs to be invoked. The authors draw heavily upon the experience of Wisconsin in framing, first, a suggested state law which will delegate to counties the power to zone rural lands, and second, in offering a specific form of zoning ordinance for the counties to enact, modelled after the existing zoning ordinances in some 18 Wisconsin counties. Following this are maps of the 14 counties of northeastern Minnesota, upon which are shown, to the detail of quarter-sections, the boundaries of proposed "conservation" zones. Vital educational processes in gaining public support for the zoning movement, found so indispensable in Wisconsin, are not overlooked in the specific recommendations.

There appears, however, to be one weakness in the so-called "Conservation Zones," as presented. There is only one class of conservation zone with its permitted uses defined in the suggested ordinance, and shown on the suggested maps. Practical experience has shown that in counties of high recreational development, requiring year-long residence to protect property investments, yet requiring also limitations on land clearing, the one restricted land use district described as a conservation zone is not sufficient. At least two, and possibly in some cases even three, classes of restricted land use districts are admissible, and provision had best be made for these when a zoning ordinance is drafted.

The chapter by Professor J. H. Allison of the Forestry Department of the University of Minnesota, on improved utilization of private forest lands, presents very frankly some of the economic problems against which private industry is struggling; but instead of suggesting the early obliteration of all private enterprises, painlessly or otherwise, as is so often the sole contribution of some modern students of forest land use, specific recommendations are made bearing on land exchange and blocking for more economic administration, and on readjustment in the taxing methods.

Public land acquisition is to be a function of both state and national governments, for it is made clear there is ample room within which both agencies may function, with plenty of privately owned land, too, to prevent them from treading on each other's toes.

Recognizing that the full benefits of zoning are not realized unless followed by the ultimate relocation or removal of stranded, costly settlers, which in turn may call for a realignment of county, town, and school district functions, the authors offer definite proposals in the way of "relocation" areas. Whether the actual processes of relocating settlers will be as simple and routine as the general tenor of the text would indicate, is not at all certain. Over-simplification in describing so fundamental a sequence is, it is felt, a definite weakness in the book.

Specific figures are offered on economies to be derived, as well as anticipated, from county consolidation, consolidation of certain county offices, and the revamping of school districts.

Bearing on the latter function is a discussion of the "unorganized" school district. It is important, because it is not the only governmental unit which may be adapted to an "unorganized" status. Unorganized towns in which all local functions may be exercised by the county, or even unorganized counties in which local functions would fall upon the state, are real possibilities in the ultimate administration of large continuous areas of public and private forest lands, unadapted to any but the most sparse human settlement.

F. B. Trenk,
Univ. of Wisconsin.

The Place of Thinning in Wattle Silviculture and Its Bearing on the Management of Exotic Conifers. By I. J. Craib, Research Officer, Forestry Department, Union of S. Africa. In *Zeitschrift für Weltforstwirtschaft, Vol. 1, Part 2-3, pp. 77-108, 1933.*

Do we now have to go to Africa to learn how to thin? Craib writes with such enthusiasm, such force, such conviction, and with such a delightful lack of respect for orthodox foresters' conceptions that the trip must be worth the while. The author works with the important wattle (*Acacia molissima* Wild.) industry which originally came from Australia. Bark for tannin is the chief product while wood is of secondary importance.

The old standard method of handling the wattle was first, to establish a very dense (40,000-60,000 seedlings per acre) crop; second, to space this into rows 12 feet apart and 1 to 2 feet in the row when the stand was about 12 months old and the trees were up to 4 feet high; third, another thinning was applied within 18 months, when the trees were spaced 3 to 6 feet in the row. The height of the trees was then about 20 feet. There is no mention of any other criterion than spacing for the thinning. The rotation age was considered 8 years, when the trees were stagnating; then the stand was clear cut and the area burned over, which started another dense crop.

The initial experiment, carried out on numerous plots, included:

1. Closer spacing between rows in order to secure better distribution, better selection, and better control of grass weeds.

2. Early initial spacing of seedlings so as to exclude any factor of suppression during the first year.

3. Application of 400 pounds of superphosphate per acre as fertilizer.

4. Rigid control of weeds and wattle regrowth by hoeing.

5. Continuous thinning designed to reduce the number of stems per acre gradually throughout the entire rotation.

All of these measures gave excellent results compared with the old practice, but it seems that the stem reduction was

not drastic enough. The stems were reduced during three years from 40,000-60,000 per acre down to 600. The old practice had reduced them to only 800 and kept it here, but the author thinks that they should be carried down to 200 or less, and that the thinning should be continued.

The similarity of Eucalyptus to wattle is pointed out, and improved measures for the former are given. Also, improved thinning practices for introduced Pinus species, such as Pinus patula and taeda, are discussed. The author emphasizes root competition as the outstanding factor. To him tolerance is "the capacity of the increment of a species for withstanding competition, and particularly the capacity for regaining normal increment *under* a period of curtailment through over-stocking." He is here pointing to something extremely important, namely: to thin before the trees are so suppressed that the stand does not respond to thinning. This is a point of importance to all of us, since many stands in America are thinned so late that they fail to respond because the trees are too weakened.

In his thinning discussion, Craib refers only to the low thinning method. Gradually he works himself, apparently independently, into the crown thinning, and his ideas approach the so-called "Worliker thinning" developed by the Bohemian forester, Bohdannecky, and especially the "Frijsenborg thinning," where one of the aims is through frequent early thinnings to avoid any direct crown friction, and thus from early youth to keep the stand in full speed. This is also what Craib proposes for the introduced conifers, but he seems to stop his thinnings in the middle of the rotation, at a time when both economically and silviculturally it should be advantageous to continue. Craib says himself: "There is little question but that relatively few dominant trees per acre at a given age will carry considerably more crown than relatively many suppressed trees of the same age." This is about the same as the statement—sometimes hard to understand—that a stand thinned frequently and well is darker than the unthinned or poorly thinned stand. In his long discussion about thinning, he seems to forget that the essential thing in all thinning is to cut for the best trees rather than to remove the poor. This holds good whether the aim, as with wattle, is maximum bark production or as in other cases, quality and quantity of wood.

Craib works under extreme climatic conditions. Some of his trees reach a height of 40 feet in 10 years. His site factors are proportioned differently from what they are in the temperate part of the northern hemisphere. He might have taken this into consideration when he frequently refers to European and American silviculture.

S. O. Heiberg,
N. Y. State College of Forestry.

Drevesinovedenie (The Properties of Wood). By Prof. S. I. Vanin, in collaboration with A. I. Kouznetzoff, H. K. Malaha, and V. P. Maltchevsky. *Forest-technological Academie, Leningrad, U.S.S.R. 548 pp., 224 illustrations. 1934.*

This imposing new text on the properties of wood is written for the forestry schools of the U.S.S.R. It is stated in the preface that this book is intended for forestry students specializing in wood technology, forest transportation, management, and economics. Principal emphasis is placed on the anatomical, chemical, physical, and mechanical properties of wood, without going into details of technological processes connected with the utilization of wood.

Of necessity, this text is somewhat encyclopedic in its nature, since it embodies a number of distinct, even though closely related subjects, such as wood anatomy, wood identification, timber physics and mechanics, chemistry of wood, etc. Because of the very breadth of scope, many subjects in this work are discussed quite briefly. However, a comprehensive, selected bibliography in Russian and foreign languages, provided at the end of the book, is intended by the author to supply the deficiencies of the text.

The book is divided into 12 chapters. The first chapter is entitled The Anatomical Structure of Wood. In it the subject of wood anatomy is dealt with in a brief manner, sufficient only to enable the student to use intelligently the data presented in the following pages. The second chapter deals with the identification of the most important woods of the U.S.S.R., and a few exotic species, by their macroscopic and microscopic characters. The gross and minute features of 35 woods indigenous to the U.S.S.R. (13 ring porous, 14 diffuse porous, and 8 coniferous) and 6 tropical woods are presented in some detail. These descriptions are accompanied by poorly reproduced photographs of the transverse, radial, and tangential surfaces of wood at low magnification (most of these photographs are attributed to Krotov—Technologie of Wood, U.S.S.R., 1933; however, the excellent originals are to be found in U.S.D.A. Circ. 66—*The Identification of Furniture Woods*, by Arthur Koehler), and some drawings depicting structural details of wood at a higher magnification.

In the third chapter of this book the author takes up the subject of the chemical properties of wood. After a brief discussion of the general chemical composition of wood, some space is devoted to the extractives such as tannins, dyes, alkaloids, etc. The discussion of extractives is followed by the consideration of the variations in chemical composition of wood produced by habitat. The balance of this chapter is given to the question of caloric values of wood, effect of high temperature, and the temperature of ignition.

The fourth chapter treats the subject of physical properties of wood. Here, in addition to color, odor, texture, specific gravity, shrinkage and swelling of wood, are also discussed the hygroscopicity of wood, the penetrability of wood by water, x-rays, ultra-violet rays and gases, thermal expansion and specific heat.

The fifth and the sixth chapters are devoted to the consideration of mechanical properties and the methods of investigation of technical properties of wood. This is followed by a comprehensive chapter on the defects in growing trees and lumber, the defects being grouped under three headings, viz. (1) those caused by bacteria and fungi, (2) insects, and (3) non-parasitic defects, such as knots, shakes, etc.

The subject of durability of wood is briefly discussed in the eighth chapter, and this is followed by a chapter on wood preservation and fireproofing.

In the tenth chapter the author deals with the distribution, availability, and the uses of native and a few exotic woods. The eleventh chapter is given over to the consideration of timber classification and lumber grades, and in the final chapter such products as lignoston, masonite, barcalite, etc., are briefly described.

Thirty pages of selected bibliography in Russian and foreign languages conclude the book. Inasmuch as the most recent Russian literature is included in this bibliography, it is of special interest as an indication of the type of research work in properties of wood carried on in the U.S.S.R. at the present time. Numerous errors are to be noted in listing of the foreign titles.

This brief outline of the contents of the book shows that the author attempted to present the entire field of wood technology and allied sciences in a single volume. The result, in the reviewer's opinion, is a valuable reference book, which, however, lacks completeness of detail to allow the student to form a clear conception of the subjects presented, without supplementary reading. To illustrate by a single instance, the discussion of cambium, its activities, and the post cambial development of wood elements is entirely omitted from the first chapter, which deals with the anatomical structure of wood.

That the author himself is cognizant of this lack of completeness is evident from the introductory remarks in which he states that his text covers a number of subjects which it is now customary to treat in separate courses, and his recommendation to supplement this volume with the more specialized texts.

Considering the dearth of good texts on the properties of wood, the author and his collaborators may well be congratulated for the task of assembling in a single volume the essential data, scattered in innumerable periodicals and test books and compiling a very extensive and valuable bibliography.

ALEXIS J. PANSHIN,
Forest Products Lab., U. S. Forest Service.

Arizona Place Names. By Will C. Barnes. *503 pages. Map. Published by the University of Arizona—General Bulletin No. 2 Vol. VI—No. 1—January 1, 1935.*

This latest volume from the pen of Will Barnes is a valuable contribution to history, ethnology, and geographical knowledge of what may be truly said to be the most historic state in the Union—Arizona. Place names of a state are historical markers on its maps. Names have long interested Barnes, just as they do many of us, but his was a practical interest for he has worked for 30 years in making this book. The volume is a veritable cross-section of Arizona history, from before 1530, when Fray Marcos de Niza came up from the South, to the present time. There are here and there stories of how certain towns, creeks, rivers, and peaks got their names, told by the pioneers, many directly to Barnes himself when in the old Indian days he was a part of the U. S. Army in the Arizona country (and won his Medal of Honor); later as he rode its mesas and canyons as a stockman, and still later as a member of the Forest Service for many years, and as Secretary of U. S. Geographic Board.

Even to one unfamiliar with Arizona the book must appeal, while to a person who has lived there and absorbed its colorful history the volume is fascinating —strange as that may seem when said of a gazetteer. Arizona's map is thick with names of the early Spanish padres, Indian chiefs, famous military names, gentile and Mormon pioneers, and of later stockmen.

Not only has Barnes been collecting information directly through all these years, but he has consulted many early and rare memoirs and volumes on Arizona expeditions and explorations, of 1874, 1865, 1854, 1850, 1845, 1833, and on back to Coronado's famous Journal of 1540. The Bibliography contains 56 titles, many by famous men. The range of history in this book is from Coronado to the national forests and the forest rangers, for Barnes acknowledges in the Foreword the great assistance the forestry men have been to him in this collection. Even in the present-day

place names there is here and there a reminder of a forest officer,—Erickson Peak (for Ranger Neill Erickson, an old-time ranger); Woolsey Lake, for the late Salisbury Woolsey; Goddards, a railroad station named for the family of W. H. Goddard, long-time forest supervisor; and Platten Spring, for Fred Platten, one-time ranger and Congressional Medal of Honor man.

"Names are such enchanting things,"—they are human, and so Barnes' book is very human history.

JOHN D. GUTHRIE,
U. S. Forest Service.

Revue Internationale du Bois. (International Review of Wood.) Edited by E. V. Letzgus. *Paris (IXe)*.

The lumber business has suffered during the depression more than many other industries; the demand is reduced and at the same time an increasing number of substitutes have been brought on the market. Besides these unfavorable factors, the lumber business suffered in Europe on account of numerous restrictions of importation and of increased customs established by many countries. An improvement of the present situation may only be expected as a result of international coöperation. A first result of many attempts made in this direction was gained in the fall of 1934, when after enormous difficulties an International Permanent Committee of Production, Business and Industry of wood was established. The objectives of this organization are in principle the same as those of the new French monthly periodical. The aim of the International Review of Wood, which is open to all contributions dealing with production and business, exploitation and consumption of wood, is to discuss problems in which an accordance between different countries exist or should exist, to establish complete and reliable statistics, and to stimulate propaganda in favor of wood and its subproducts and to discourage wood substitutes. The following enumeration of a few articles which appeared in 1934 show what a large field is covered:

C. I. B. International Committee of Wood.

The Forests and Lumber Industries of Sweden.

The Forests of Finland and their Exploitation.

The Woods of the Colonies in the Depression.

The Manufacture of Charcoal, etc.

A Sketch of the Systematic Classification of the Woods.

The Wood Question and the Colonial Economic Conference of 1934.

The Colorisation and Protection of Wood by Injection of Live Trees.

Under the title "Documentation" are given valuable references, statistical data, and notes on forestry meetings and other conferences. The different issues contain also reviews of books and articles dealing with the subjects discussed by the journal.

The appearance of a periodical like the International Review of Wood is a characteristic of the present (and perhaps still more of the future) conditions in economic forestry. The somewhat new situation has recently been presented by Franklin Reed in an editorial in the February JOURNAL OF FORESTRY. The present review may be considered as an illustration of the fact that European as well as American foresters are realizing the problem of economic forestry is not merely how to produce timber, but more and more how to sell it.

H. ARTHUR MEYER,
Washington, D. C.

Acta Forestalia Fennica. 40. Special issue in honor of 25th Anniversary of the Society of Forestry in Suomi (Finland). *901 pages, Helsinki, 1934.*

This issue of a well-known forest periodical is a special number in celebration of the 25th anniversary of the Finnish Forestry Society (Finska Forstsamfundet). The number and variety of papers, some 40 in number, preclude the possibility of discussing the subject matter of each one in detail. In many cases the original text is in Finnish accompanied by a quite complete resumé in German; when the original is in Swedish there is a short resumé in both Finnish and German. Portraits of Cajander and other Finnish workers in forest research are included in a historical sketch of the activity of the Forestry Society. The other articles, covering every field of forestry, are also well illustrated. A more complete index would be highly desirable to render a volume of this kind more permanently useful.

H. I. BALDWIN,
Caroline A. Fox Research and Demonstration Forest.

Grundsätze und Regeln für den zweckmässigen Betrieb der Forsten. (Fundamental Laws and Rules for Rational Forest Management.) By Count C. D. F. Reventlow. (*MS before 1827*) *edited and introduction by Prof. A. Howard Gron, xxxii + 156 pp., 3 portraits, charts, Copenhagen, 1934.*

Count Reventlow has always been known as the father of Danish forestry and his epoch-making work is now, for the first time, made available to the world at large. He advocated frequent thinnings and a radical departure from the over-dense stands and long rotation called for by Hartig. After his death in 1827 his methods were changed by successors and his work largely forgotten. Fifty years later a Danish manuscript was found in the archives at Peterstrup, Reventlow's estate, and published in 1879 through the influence of P. E. Müller. This has had a profound effect on the trend of Danish forestry since, especially on the development of the well-known Danish system of thinning. A German manuscript was found at the same time, but not published. It was longer and more complete than the Danish manuscript but covered much the same ground. Some parts of it were translated and added to the Danish manuscript in 1879. It is now published for the first time with the omission of some statistics and short passages of no interest today.

Reventlow was born in Copenhagen in 1748. His father was a privy counsellor at the Danish Court, and his mother a baroness. After preliminary schooling in Denmark, including three years at the Soro Academy in Seeland (now famous among foresters for the forest managed by H. Mundt), he spent two years at Leipzig and travelled throughout Europe, including England, studying forestry. His education finished, he began his career with the Danish State, first in what may be called the Department of Commerce and eventually in the "Rentekammer" where he became president of the chamber and minister in 1797. His forestry activities were carried on largely on his own estate in Laaland and at Brahetrolleborg. Danish forestry was dominated by the classical German principles of clear-cutting and planting, maintenance of dense stands, low thinnings and long rotations, as exemplified in the works of Georg Hartig. Reventlow advocated a more economic plan calling for heavier

and more frequent thinnings, but his proposals received scant attention from the government during his lifetime. In 1813 he retired from official duties and devoted his time to the management of his estate and continuation of his forestry researches. He died in 1827 before their completion. He did, however, have copper plates made of many graphs of stem-analyses.

The early pages of the book are packed with references from all parts of Europe on the influence of spacing on growth rate of beech and oak. (His experience with conifers was limited.) From his travels in England, Reventlow had come in contact with the writings of John Evelyn, for which he had great respect. He builds up evidence in opposition to Hartig's theories, and yield tables, drawing his conclusions with caution, reflecting his sound scientific reasoning. He concludes that oak and beech were grown much too closely in Germany, and possibly too openly in England. At that time it took courage and bold thinking to break away from the powerful tradition of Hartig.

Reventlow's plan for forest management laid stress on economics. He reasoned that forests were made for man, and forestry should yield an appropriate return financially as a first consideration. Business aims should come first and refinement of silviculture be secondary. At the same time he had permanent management of the land in mind and took sustained yield for granted. His 21 rules for management were formulated on the basis of his experience and observations. Most of them are as sound today as when they were written over 100 years ago. These rules included the division of the forest into blocks and compartments; the determination of cutting cycles and rotations (80 years for beech, and not over 120 years for oak, or when c. a. i. in volume drops below 4 per cent); and detailed recommendations for felling, pruning of dead branches and correct spacing of plantations.

The reader cannot fail to be impressed that here is silvicultural wisdom based on direct observation and study of the forest itself. The author was not too preoccupied with the immediate work at hand to prevent reflection. Reventlow's treatise has come down to us as the result of his study of the forest, and tardily takes its place among the classics of forest literature.

HENRY I. BALDWIN,
Caroline A. Fox Research and Demonstration Forest.

Opredelenie Vskhozhesti Semian Drevesnykh Porod Metodom Okrashivania. (Determination of the Germination Capacity of Forest Tree Seeds by the Dyeing Method.)[1] By E. Y. Shafer-Safonova, M. I. Kalashnikova, and A. S. Kostromina.

This paper forms part of a separate mimeograph publication issued by the Vssesoyuzny Naouchno - Izsledovatelsky Lessokulturny i Agrolessomeliorativny Institut (All-Union Research Institute for Silviculture and Improvement of Farmland by Afforestation), the so-called "Vnilami" and its Laboratory for the study of the physiology of tree species, Moscow, 1934, pp. 1-44.

The experiments described are based upon the fact that dead tissue is highly permeable to acid dyes, while live tissue is practically impermeable. A number of different organic dye substances—among them acid violet 6B, indigo car-

[1]Translation filed in U. S. Forest Service Library, Washington, D. C.

mine, nigrosine, fast red dyes, gentian violet, safranine, methylene green, methylene blue, methyl violet, and Bismarck brown—have been used by Russian and other foreign workers to determine the viability of seed. The authors confined their experiments to a single dye, indigo carmine, using concentrations varying from 1:200 to 1:5000 and the staining time varying from 2 to 30 hours.

Tests were made on seeds of varying quality of the three species yellow acacia (*Caragana arborescens* Lam.), Scotch pine (*Pinus silvestris* L.), and Norway spruce (*Picea excelsa* L.). For these three species they obtained best results with a dye concentration of 1:2000. For acacia and pine the staining time required was two hours, while for spruce better results were obtained with three hours' staining.

The difficulties in applying this method involve not only the determination of the proper staining procedure, since high concentration of dyes actually kill living tissue, but also the correlation between degree of staining and seed viability. Each of these determinations must be worked out separately for each species. Since the embryo is the part of the seed which develops into the new plant, the effect of stain on it must be determined. Satisfactory staining of *Caragana* was obtained only after removal of the seed coat. For pine and spruce it was necessary to remove also the endosperm, so that the naked embryo could be subjected to the stain. From microscopic examinations it was found that when the apical cell of the embryo radicle was stained the embryo was unable to develop, but if only cells of the root cap were stained a normal seedling was produced. For *Caragana*, the apical cell is very near the tip, hence if the staining extended beyond a dot at the tip the seed was incapable of germination. In pine and spruce the apical cell is about one-third the distance from the radical end of the embryo, hence if an embryo were stained for more than one-third its length it was incapable of producing a seedling.

Some of the results obtained are given in the following table.

Species	Percentage of germination as determined by staining	Percentage of germination as determined by sprouting
Yellow acacia	78.7	72.6
	38.4	40.6
	17.7	20.2
Scotch pine	90.8	95.0
	75.9	75.2
	45.2	45.6
	35.1	27.8
Norway spruce	91.6	93.8
	39.0	28.2
	9.4	4.3

Most of these results are well within the limits of variability among different samples of the same lot of seeds, which indicates that once the method has been carefully worked out it may be applied with a reasonable degree of assurance.

The labor required for the staining process is from two to three times as much as that required for germination tests, due largely to the difficulties involved in removing seed coats and endosperm and extracting uninjured embryos. However, the entire job may be completed within two or three days for 500 seed samples, while germination tests must run 18 days or longer. The method offers particular promise for seeds slow to germinate.

HARDY L. SHIRLEY,
Lake States For. Exp. Sta.,
Univ. of Minn.

CORRESPONDENCE

Ballyhoo for Bark

Lake City, Fla.,
Jan. 22, 1935.

Mr. Earle Kauffman,
The American Forestry Association,
Washington, D. C.

Dear Sir:

I have just read your article in the November Journal of Forestry.[1] It is very effective and appealing; you have done a good job. As I read it, some thoughts arose in my own mind and I trust it will not offend if I communicate them. My circumstances and history are very different from yours. For one thing, I must be somewhere from two to three times as old.

The power of ballyhoo you have pictured admirably, its place and its limitations. Often have I wondered what percentage of it was necessary to carry a thing over big with the public—it must be more than half.

Then this I have seen—that the effect often wanes as it waxes. Perhaps the artists find out their errors or that they are barking up the wrong tree entirely; so, as quietly as possible they shift ground, turn the spotlight onto something else. The thought of that is often a comfort to the quiet men who don't, probably can't, participate, whose fixed habit it is to study for what is sound and will endure. Perhaps it is true that in the main this sort of thing accomplishes more good than harm, but it shouldn't be forgotten that it usually costs a lot.

At one point you refer to the usual disagreement among those supposed to know, causing confusion to the man in the street—say that foresters should be agreed. Too much to expect, I think; anyhow, in my forty years with forestry it never was so, and I don't suppose it ever was with any such movement. Don't see how it can be, considering the variations in the human mind. Therefore, as it seems to me occasions are still likely to arise where a man must take his own stand for conscience's and integrity's sake.

At one point you speak of dramatizing and humanizing forestry. I appreciate what you say; my reaction concerns the direction of it. That, I expect, may be considerably different from what you have in mind.

To me United States lumbering history is a great drama. I am old enough to have known many of the historic figures; their daring, their struggles do immensely appeal to me; then on the other side I reflect that their products were human necessities. That Lake States lumber, for instance, housed the Plains and Prairie country. And as time rolls round, native timber becomes scarce, and it is clear that if we are to have timber products we must grow the timber. I see many of the same sort of men responding in the same spirit, inaugurating enterprise that amounts to exactly that. Risk, concentration, labor are again involved in it. That is something they are used to and that suits them. I don't suppose you can at all appreciate the tre-

[1]Kauffman, Earle. Ballyhoo for Bark. Jour. For., 32(8):834-836.

mendous interest I have in timber-growing enterprises. Familiar with both North and South, this idea has recently come into my mind prominently—that there is an instinct to produce in men. It's turning more and more in this direction. I believe myself we shall go wrong if we fail to give it all the room it will take.

Ballyhoo—you have described it and suggested a field for it. I agree. But I'd hate to have anyone believe that the other thing was fruitless or devoid of reward, and the best way I know to convey that idea is to tell some things from my own experience.

Way back in 1893, I started in Maine. Two years later, in the summer of 1895, I spent a season on the Kennebec River, getting history of the cut, assembling available figures for stand, making studies of my own on the condition of the lands for growth, finally making a guess at the amount of pulpwood standing, at yearly growth on the drainage, and on the relation of that to expected cut. Of course it was guess work, but it was honest, as was made clear in the report.

Last season I spent some time in the same territory, got figures for the cut of the thirty-eight years that have elapsed, ascertained what the timber men of the region consider is standing there today, and put the figures together. And when the result came out it staggered me, it checked out so closely with what I first, and later other men, had believed. No ballyhoo there, but a very deep personal satisfaction. And meanwhile a country prospering on the basis of its forests, giving them continuously better treatment, looking ahead to continuance of the same. Forestry and forest industry are rather nearly one thing in that country. At any rate there is cooperation, not opposition, between the two.

Now, this is a shot in the dark. I may not hit you at all, and that, if it proves so, will be all right. But chance touches with the younger men I have felt very fruitful sometimes, and you are in an influential place.

AUSTIN CARY,
U. S. Forest Service.